International Capital Flow Pressures

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Abstract

This paper presents a new measure of capital flow pressures in the form of a recast Exchange Market Pressure index. The measure captures pressures that materialize in actual international capital flows as well as pressures that result in exchange rate adjustments. This new formulation is theory-based, relying on balance of payments equilibrium conditions, international asset portfolio considerations, and adjusting for biases due to currency valuation effects in central bank foreign reserves portfolio. Based on the modified exchange market pressure index, the paper also proposes the Global Risk Response Index, which reflects the country-specific sensitivity of capital flow pressures to measures of global risk aversion. Using data on a large sample of countries over time, we demonstrate time variation in the effects of global risk on exchange market pressures and the changing risk-on or risk-off status of currencies.

JEL Classification: F32, G11, G20.

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1 Introduction

International capital flows are demonstrated as consistently important for economic outcomes and strongly driven by global factors(Milesi-Ferretti and Tille [2011], Forbes and Warnock [2012], Fratzscher [2012], Rey [2015a], Avdjiev et al. [2017]). Global risk aversion tends to drive capital flows into emerging market countries when global risk perceptions are low, and out again when global risk perceptions increase. Advanced economy monetary policies matter too, as illustrated by the sharp swing in emerging market capital flows following the Federal Reserve's tapering talk in 2013 (Shaghil et al. [2015], Ghosh et al. [2014], Aizenman et al. [2014a], Eichengreen and Gupta [2014] and Mishra et al. [2014]). In advanced economies, global risk aversion is linked to capital flows and appreciation pressures on so-called safe haven countries (Ranaldo and Soederlind [2010], Botman et al. [2013], de Carvalho Filho [2013] and Bundesbank [2014]). These two phenomena, safe haven flows to advanced economies and risk-on risk-off capital flows to emerging markets, are intimately connected. While generalizations often are made with respect to the particular status of specific countries or groups of countries, we will argue that these are not necessarily valid, and certainly are not intrinsic country features.

The approach of the literature on international capital flows characterizes global risk sensitivity based on the relationship between data on capital flows and measures of global risk aversion. However, capital flow data are often imprecisely measured, incomplete, and available with quarterly frequency at best. As risk-off episodes are often shorter, they may not be observable in quarterly data. Moreover, data on capital flows based on balance of payments statistics are often only available with a lag. More importantly, measurement of capital flow sensitivity based on realized capital flows will differ depending on whether a country's monetary authorities intervene in foreign exchange markets to influence the local currency exchange rate, or whether capital flow pressures result in changes in the exchange rate or interest rate sufficient to discourage capital flow pressures from being realized in actual flows. Recent event studies of international monetary spillovers underscore this point, with full international capital flow pressures reflected in actual flows, as well as in exchange rate or interest rate changes (Chari et al. [2017]). These shortcomings make realized international flow quantities an imprecise measure of the capital flow pressures that arise in response to risk and other factors.

The typical approach in the safe haven literature for measuring sensitivity to global risk factors is instead to rely primarily on asset price data, measuring the degree to which a currency experiences appreciation pressure or exhibits excess returns when global risk sentiment increases (Ranaldo and Soederlind [2010], Habib and Stracca [2012], Fatum and Yamamoto [2014] and

Bundesbank [2014]).[1] Measures based purely on observed currency movements, however, also do not take into account that some countries may respond to currency pressures by intervening in the foreign exchange market or changing the policy rate, thereby moderating or preventing the signal value of exchange rate movements.

In this paper, we propose a metric that combines price and quantity information, within an exchange market pressure index (EMP) in the spirit of Girton and Roper [1977], Eichengreen et al. [1994] and Kaminsky and Reinhart [1999]. The EMP we propose as an alternative gauge of net capital flow pressures takes into account outright capital flows as well as exchange and interest rate changes. It relies on data which is available in monthly frequency and is more up-to-date than outright capital flows. However, we depart from the earlier literature on exchange market pressure indices, which has operated with a number of ad hoc assumptions about how the components of the index should be weighted against each other. These earlier assumptions may bias the exchange market index, and raise concerns about its usefulness. Instead, we propose a modified conceptual framework that is grounded in international asset market equilibrium conditions, and recognizes alternative exchange rate regimes as well as the multi-currency portfolio composition of central bank foreign exchange reserve holdings. The resulting EMP index is less likely to be biased, is available at monthly frequency, and is constructed specifically to capture capital flow pressures. Moreover, we provide a simple theoretical construct which maps pressures arising from a range of domestic and foreign drivers.

The EMP is useful for characterizing more recent patterns in capital flows, and for example, could be used to revisit the analysis of stops and surges in capital flow pressures by using higher-frequency financial variables. However, as a net measure of capital flow pressures, the EMP does not contain information on the players which serve as a source of the pressures, including whether they arise from stops, flights, surges or retrenchments, as nicely articulated in Forbes and Warnock [2012].

We illustrate the usefulness of our exchange market pressure index for a set of advanced and EU countries, presenting evidence from the global financial and European debt crises. Furthermore, based on the EMP, we propose a new measure, the Global Risk Response (GRR) index, to empirically categorize the link between global risk factors and changes in international capital flow pressures by country. The index is constructed as the correlation between monthly observations of a measure of global risk sentiment and monthly observations of the EMP. Using the VIX as a measure of global risk to illustrate the GRR, we demonstrate that it is useful for sorting countries according to whether their exchange market pressures exhibit risk-on behavior (i.e. inflows pressures which risk appetite is high), or risk-off behavior (so-called safe haven type

[1] Wong and Fong [2013] is an exception in that they rely on options prices, and so-called risk reversals, to gauge the degree to which financial market participants expect currencies to behave as safe havens.

inflows when risk appetite is low). The GRR allows us to express the evolution over time of this cross-country sorting. An important observation is that, while currencies have some persistence within this categorization, the characterizations of countries are not stagnant. Emerging market currencies occasionally behave as risk-off currencies, while advanced country currencies occasionally behave as risk-on currencies.

The paper is structured as follows. In Section 2, we discuss exchange market pressure indices used in the previous literature and detail a number of concerns with such measures. Section 3 presents our theoretical framework for deriving an alternative exchange market pressure index that is closely tied to capital flow pressures, and for addressing the concerns around the construction of previous measures. In Section 4, we discuss empirical implementation of the EMP, including the consequences of various weighting and scaling choices. Section 5 compares the EMP relative to realized net capital flows in a sample of 47 countries. The Global Risk Response index, as a summary measure of the response of a country's capital flows to global risk, is presented in Section 6, which also discusses the stability and persistence of currency risk-on and risk-off status. The final section discusses the implications of our findings and concludes. The appendix contains additional analysis, information and charts.

2 Previous Exchange Market Pressure Indices

The variants of the exchange market pressure index (the EMP) used in prior literature take the form of a weighted index of changes in the exchange rate and changes in official foreign exchange reserves along the following lines:

$$EMP_t = w_e \left(\frac{\Delta e_t}{e_t} \right) - w_R \left(\frac{\Delta R_t}{S_t} \right) + w_i(\Delta i_t) \tag{1}$$

where the index pertains to a particular country at a specific point in time (country subscripts not included here), $\left(\frac{\Delta e}{e}\right)$ is the percentage change in an exchange rate defined as domestic currency per unit of foreign currency, ΔR is the change in the central bank's foreign exchange reserves, and S is a scaling variable for the reserve changes. Some variants of the index include the monetary policy actions of a country, with Δi representing the change in policy interest rate. $w_{k,t}$ are the weights at which components, denoted here by $k = (e, R, i)$, enter the index. Scaling choices reflect views of the relative magnitude or importance of official foreign exchange purchases or sales. Weighting choices are used to filter out noisy signals from exchange rates and official reserve changes. The weights, scaling factors, and the specific definition of the exchange rate (e.g. bilateral against the dollar, or multilateral) used for producing the EMP vary across studies. This variation reflects constructive efforts to have a practical basic measure, but also reflects the

Study	EMP Definition[a]	Weighting Scheme[b]	Exchange Rate Definition
Girton and Roper [1977]	$\frac{de}{e} + \frac{dR}{M0}$	Equal	Nominal bilateral against USD
Eichengreen et al. [1994]	$w_e \frac{de}{e} + w_R d(i - i^*) - w_I \frac{(dR - dR^*)}{M1}$	Precision	Nominal bilateral against DM
Weymark [1995]	$\frac{de}{e} + w_R \frac{dR}{M}$	Model based price and interest elasticities	Nominal bilateral against USD
Sachs et al. [1996]	$w_e \frac{de}{e} - w_I \frac{(dR - dR^*)}{R}$	Precision	Nominal bilateral against USD
Kaminsky and Reinhart [1999]	$\frac{de}{e} + w_R \frac{dR}{R}$	Precision	Real effective
Aizenman et al. [2012b][c]	$w_e \frac{de}{e} + w_R d(i - i^*) - w_I \frac{(dR - dR^*)}{R}$	Equal and Precision	Nominal bilateral against USD
Aizenman et al. [2015]	$w_e \frac{de}{e} + w_R d(i - i^*) - w_I \frac{(dR - dR^*)}{R}$	Precision	Nominal bilateral against varying base currency
Patnaik et al. [2017]	$\frac{de}{e} - w_I \frac{dR}{M0}$	Empirical estimates of exchange rate elasticity to interventions	Not disclosed
Goldberg and Krogstrup [2017][d]	$\frac{de}{e} - \Omega(\frac{dR}{\Pi_e}) + \frac{\Pi_i}{\Pi_e} di$	Model based weight correcting of valuation related bias in reserves changes	Nominal bilateral against USD

[a] e is the exchange rate, R is central bank foreign currency reserves measured in USD, i is the interest rates, $M0$ is the monetary base, $M1$ is narrow money. Asterisks denote foreign or global variables.
[b] Precision weights as defined in the text.
[c] Both Reserves and $M0$ used for scaling reserves.
[d] Π_e and Π_i are based on the GK derived exchange rate elasticities based on gross external asset and liability positions and income balances.

Table 1: **Exchange Market Pressure Indices**

weak theoretical underpinning and lack of consensus on the logic of the construction. Table 1 presents an overview of the variants of the EMP in the prior literature, summarizing included components, their scaling, weighting and the exchange rate definition used.

Some features of these EMPs may induce bias or generate unnecessary imprecision. First, the choice of scaling of changes in reserves is not neutral, as it affects the amplitude of the variation in reserves changes. While Girton and Roper [1977] and Weymark [1995] present monetary models and suggest that changes in reserves should be scaled by the monetary base, those derivations are based on assumptions about the structure of financial markets which are unlikely to hold, including perfect capital mobility and perfect substitutability across assets of different countries.[2] Other researchers used the level of reserves themselves for scaling (Kaminsky and Reinhart [1999])

[2] Models based on money market equilibrium conditions are problematic, even if updated, since central banks have engaged in quantitative easing or other policies that change the monetary base without relating to broader money or the foreign exchange market.

or a narrow monetary aggregate (Eichengreen et al. [1994]) in order to provide perspective on the relative magnitude of reserve losses in a crisis event. However, scaling by the initial level of reserves (effectively using relative changes in reserves) results in a higher amplitude of scaled reserve changes when the initial level of reserves is low relative to when it is high. Scaling by a monetary aggregate makes the scaling sensitive to the variation of money multipliers over time and across countries. Neither approach to scaling provides a relevant concept of equivalence between the currency depreciation and reserve losses components to justify an adding up of prices and quantities within the EMP.

Second, approaches to weighting the different components of the index vary in relevance and conceptual underpinnings. The early theoretical treatments in Girton and Roper [1977] and Weymark [1998] do not take into account the size and structure of foreign exchange markets and external balance positions. The derivation based on the monetary approach in Weymark [1995] suggests that the change in reserves should be weighted by the elasticities of money demand to interest rates, and prices to exchange rate, as these are the main channels of balance of payments adjustment in such models. While Weymark [1995] applies such weights empirically, most other studies remain "agnostic" as to whether such elasticities can be appropriately estimated or make sense, and instead employ precision weights.

Precision weights are constructed by weighting the components of the index by their sample variance. This approach ensures that the variation in all the elements of the EMP contribute equally, and hence, that none of the components dominate the index.[3] These weighting schemes do not account for the information inherent in the central bank's exchange rate policy regime about the relative role the components, however, as noted in Li et al. [2006]. Precision weights give more weight to the component with less variation. In pegged exchange rate systems, this would tend to be the exchange rate, while changes in reserves clearly contain more information on exchange market pressures under such regimes. Other contributions, e.g. Tanner [2002] and Brooks and Cahill [2016], apply equal weights to exchange rate and official reserves. Equal weights similarly place weight on movements in official reserves even in countries with fully floating exchange rates, where such movements are unlikely to reflect interventions and are more likely due to portfolio valuation effects. Patnaik et al. [2017] constructively proposes weights based on the sensitivity of the exchange rate to changes in reserves, but does not firmly underpin this type of weight within a conceptual framework.

Third, the prior constructions ignore exchange rate-induced valuation changes in central bank reserve portfolios that can bias the index. In practice, central bank reserve portfolios are comprised of a basket of currencies, instead of exclusively being invested in one currency; foreign

[3]Eichengreen et al. [1994] offers a thorough discussion of the advantages and drawbacks of using this weighting scheme.

exchange intervention activities typically engage only the currency against which the exchange rate pressure is realized (Goldberg et al. [2013], Eichengreen et al. [2016]). US dollars, on average, represent 60 to 65 percent of total foreign reserve portfolios.[4] The value of reserves reported in USD equivalents will thus fluctuate when the exchange rate vis-à-vis the currencies in which the reserves are held fluctuates, without such fluctuations reflecting foreign exchange interventions or international capital flow pressures. Such valuation effects can impart a bias or imprecision in the exchange market pressures associated with capital inflows.[5] When reserves are measured in the currency against which a country manages its exchange rate, e.g. in US dollar equivalents in the case of countries which peg to the US dollar, the scope for bias is smaller as US dollar assets would dominate reserves to a greater degree. The bias depends on both the content of other foreign currencies within reserve portfolios, and how these currencies comove with the main foreign anchor currency. As we also make clear in Section 3, fluctuations in reserves due to valuation effects reduce the precision of reserves changes as a signal of capital flow pressures. Indeed, the potential for bias and imprecision of the index is further increased by precision weights, which increase the relative weight of reserve changes exactly when the exchange rate fluctuates more. We show the effects of this source of inaccuracy and potential bias, and propose associated adjustments to the EMP.[6]

Fourth, as is clear from Table (1), the previous literature has used different definitions of the exchange rate. This choice of currency is important because the exchange rate component of the EMP index is not an absolute measure of pressure, but is relative to the currency against which the exchange rate is defined. For example, suppose we represent the exchange rate of a country x as the bilateral rate against the USD, and suppose that the USD is appreciating against both the local currency and against the euro during a specific risk-off episode. Even if country x is also experiencing increased net capital inflows with its local currency appreciating against the euro, the EMP construction registers a depreciation with increased exchange market pressure in

[4] Data on the full currency breakdown of central bank foreign currency reserves is not readily available in cross country comparable data sources. The IMF's COFER database keeps data for individual countries strictly confidential, providing a breakdown across advanced economies and emerging and developing countries.

[5] For example, when reserves are measured in local currency equivalents, increases in the value of the local currency against the foreign currency result in a fall in the domestic currency value of reserves, all else equal. In the absence of adjusting for valuation effects, this fall will incorrectly be interpreted as an indication of capital outflows.

[6] This point raises a broader conceptual issue of how well the change in foreign exchange reserves captures foreign exchange market pressures at any given time (Neely [2000]). In the periods before and after the global financial crisis, some countries hoarded foreign exchange reserves in an effort to secure perceived insurance against future potential disruptions in access to international capital markets (Aizenman et al. [2014b]). Reserve management strategies might likewise be used to absorb commodity terms of trade shocks (Aizenman et al. [2012a]) or be held for mercantilistic motives (Dooley et al. [2004], Bonatti and Fracasso [2013]). Note that if reserves are persistently accumulated over time, these would register as positive changes in reserves and hence as a level shift in the reserve accumulations, however this should not necessarily lead to a higher variance of these changes. All else equal, reserve purchases or sales would affect the foreign exchange market equilibrium and should balance out with the response of the exchange rate as long as the two are weighted correctly in the exchange market pressure index.

dollar terms. No exchange rate definition perfectly solves this problem, given the relative nature of exchange rates, but it raises the point that it is important to choose an exchange rate definition that more closely matches the main monetary anchor currency of a country. It also should match up with the currency denomination of official reserves changes used in the EMP, and hence, even using effective exchange rates may not be accurate, and the right anchor currency to choose may be changing over time. Applications of EMP require careful discussion of the relevant choices of units.

Finally, previous EMPs differ in the components included. Most include the change in the exchange rate and the change in reserves, excluding monetary policy interest rate changes.[7] This exclusion can be justified by monetary regimes in which policy rates are not fully endogenous to capital flow pressures, serving as a driver of pressures instead of a response to pressures. Alternatively, the exclusion of policy rate changes is often a more practical consideration associated with a lack of consistent data over time or across countries on the relevant policy interest rate. Indeed, the problem of identifying the right policy rate is compounded since the global financial crisis, when some countries arrived at the zero lower bound and many countries changed the tools used for monetary policy, such as shifting to quantitative easing and forward guidance.

To guide our choices for the construction of an EMP, Section 3 sets up a conceptual framework that directly links international capital flow pressures to exchange market pressures. We show that the scaling of reserves and the weighting scheme are not independent, and that it is not the monetary base or GDP, but rather the sensitivities of gross foreign asset positions and interest on foreign liabilities to expected rates of return and shocks that matter for combining official reserve changes with exchange and interest rate changes. Essentially, we argue that there is an equivalence between the amount of exchange rate depreciation and the amount of official reserve sales that are needed for offsetting exogenous quantities of private capital flow pressures. A balance of payments equilibrium condition along with foreign asset and foreign liability demand conditions underpin this equivalence. Moreover, rather than weighting the index components based on their relative variances, our framework suggests equal weights in the absence of valuation changes in reserves, and a weight correction for changes in reserves if the measure of reserve changes does contain valuation fluctuations. This correction applies only to reserves, and not to the exchange rate and interest rate changes.

[7] Recent analyses focusing only on exchange rates as in the safe haven literature can be viewed as a special case of the EMP for freely floating currencies.

3 Modelling Exchange Market Pressures

The theoretical foundation we propose for the exchange market pressure index takes an international financial flow perspective and is based on an international portfolio balance approach, following the long tradition of Girton and Henderson [1976], Henderson and Rogoff [1982], Branson and Henderson [1985], Kouri [1981], Blanchard et al. [2005] and Caballero et al. [2016]. The key conceptual point is that net international flow imbalances for a currency, in quantity terms, are offset in equilibrium by a set of price (exchange rate, interest rate) and quantity (official interventions using foreign exchange reserves) adjustments. The additivity across the price and quantity terms is done using a set of scaling and weighting terms to isolate what is truly exchange market pressure (as opposed to valuation effects) as well as to identify conceptual equivalency factors. The equivalence factors derive from the balance of payments identity and international asset demand functions that incorporate imperfect asset substitutability. Any given excess supply or demand for a currency can be offset by an equivalent amount of foreign exchange intervention quantity, by an endogenous exchange rate movement, or by a change in the domestic policy rate sufficient to generate a private balance of payments flow. In particular, we show below that the equivalencies are driven by the elasticities of response of foreign assets and foreign liabilities to exchange and interest rate changes, stocks of outstanding foreign asset and liability positions, and ex ante initial terms of financing on such positions. The combination of exchange rate changes and reserves (or other measures) in response to observed pressures are shown to depend on the exchange rate regime in place.

Below we set out the main building blocks of the model, which describes the external financial position of an open economy. We derive the EMP in the case where reserves are denominated only in one foreign currency and measured in equivalents of this foreign currency (in which case, there are no valuation fluctuations in reserves.) We then introduce a broader treatment of the official reserves portfolio and the exchange rate regime, demonstrating how the expression for the EMP as a measure of capital flow pressures changes with reserves comprised of assets denominated in other currencies. Since outright valuation adjustment of reserves is not possible because the currency composition of reserves is not observed, we suggest proximate adjustments.

3.1 Conceptual Framework

For any country, Home, the balance of payments identity captures flows of financing vis-à-vis the rest of the world, Foreign, over a unit measure of time t, which we consider as short, e.g. one month. The balance of payments, denominated in foreign currency equivalents, is given by

$$(EX_t - IM_t) + \left(i_t^* FA_{t-1} - i_t \frac{FL_{t-1}}{e_t} \right) + \left(\frac{dFL_t}{e_t} - dFA_t \right) = dR_t \tag{2}$$

where the first term in the first parentheses is the trade balance comprised of foreign currency denominated nominal value of exports EX less imports IM. The second term in parentheses contains the net foreign investment income received by Home residents on their gross nominal holdings of foreign assets denominated in foreign currency ($i^{*}FA_{-1}$), less the returns paid out to Foreign residents' on nominal holdings of Home assets denominated in domestic currency, (iFL_{-1}), converted to foreign currency equivalents. The exchange rate e between the Home and Foreign currencies is defined in terms of units of Home currency per one unit of Foreign currency. The third term in parentheses is the private net capital inflow denominated in foreign currency equivalents, represented by the difference between the valuation adjusted change in residents' gross foreign liabilities (foreigners' claims on domestic residents) and the change in residents' holdings of gross foreign assets. The balance of payments flows on the left hand side are zero under a fully flexible exchange rate regime, or have some offset by changes in official foreign exchange reserve balances dR in regimes wherein some official foreign exchange market intervention activity occurs.

Gross foreign assets and liabilities positions are functions of domestic and foreign nominal financial wealth, W_t and W_t^{*}, respectively:

$$FA_t = \frac{W_t}{e_t} \cdot \left[1 - \alpha(i_t - i_t^{*} - \frac{E(e) - e_t}{e_t}, s_t)\right] \tag{3}$$

$$FL_t = e_t \cdot W_t^{*} \cdot \left[1 - \alpha^{*}(-i_t + i_t^{*} + \frac{E(e) - e_t}{e_t}, s_t^{*})\right] \tag{4}$$

where W_t and W_t^{*} are both denominated in their respective local currencies and $i - i^{*} - \frac{E(e)-e_t}{e_t}$ is uncovered interest rate parity (UIP). The α functions capture the shares of residents' portfolios that are invested in domestic assets (also referred to as the degree of home bias) and depend, first, on the expected relative risk-adjusted return on foreign versus domestic assets as captured by deviations from UIP,[8] and, second, on a risk or investment sentiment measure pertinent to each countrys investment decisions. We allow s_t and s_t^{*}, which capture factors that are independent of relative expected returns, to be independent of each other and differ both in size and sign. We assume that α and α^{*} are positive, i.e. $\alpha'_{uip}, \alpha'_{uip^{*}}, \alpha'_{s}, \alpha^{*'}_{s^{*}} > 0$. [9]

Totally differentiating (2), (3) and (4), and rearranging terms yields:

[8] This conceptual set-up is couched as a two country world. From the perspective of Home balance of payments, $1-\alpha^{*}$ is the share of Foreign wealth investment in Home assets. In a multi-country world, α^{*} is more appropriately described as the share of Foreign wealth in rest of world investments.

[9] The difference in level between α and α^{*} conditional on the arguments reflects the differences in size of domestic and foreign financial asset markets.

$$\frac{de_t}{e_t}\Pi_e - dR_t - di_t\Pi_i = -\Pi_{i^*}di_t^* - \frac{FL'_{s^*}}{e_t}ds_t^* + FA'_s ds_t - \frac{FL'_w}{e_t}dW^* + FA'_w dW \tag{5}$$

where

$$\begin{aligned}
\Pi_{i^*} &= \frac{1}{i_t^*}\left[FA_{t-1}(i_t^* - \epsilon_{i^*}^{FL}) + \epsilon_{i^*}^{FA}\frac{FL_t}{e_t}\right] \\
\Pi_i &= \frac{1}{i}\left[\frac{FL_t}{e_t}[i_t - \epsilon_i^{FL}] + \epsilon_i^{FA}FA_t\right] \\
\Pi_e &= \frac{FL_{t-1}}{e_t}i + \epsilon_e^{FL}\frac{FL_t}{e_t} - \epsilon_e^{FA}FA_t
\end{aligned} \tag{6}$$

On the right hand side of equation (5) are terms that reflect exogenous drivers of international financial flows vis-à-vis the Home country, while the left hand side terms are Home policy measures that might offset pressure from imbalances in the demand and supply for Home currency.[10] The parameters in front of the respective terms reflect the channels through which capital flow pressures are realized and adjusted. For example, when there is a shift in home risk sentiment, the degree of foreign asset sensitivity FA'_s (which maps to $\alpha'_s > 0$) is the key variable of interest in the effect working through the balance of payments and leading to wealth retrenchment back Home. Likewise, an exogenous increase in Home wealth serves as an adverse shock to the Home balance of payments while increased Foreign wealth raises foreigners' demand for Home assets, as captured by foreign liability growth in Home. Higher foreign interest rates make Home assets relatively less attractive, and reduce foreign demand for these while raising Home demand for foreign assets. The magnitude of the resulting net effect is shown through the collection of effects in Π_{i^*} where we also define elasticities ϵ of foreign assets on liabilities with respect to i^*.

Further arranging terms, we express the combination of policy adjustments on the left hand side in units of currency depreciation, thus deriving our EMP metric.

[10] For analytical convenience, and because our interest is in short term capital account pressures on the balance of payments, we assume that net exports are stable in the short term with international prices and aggregate demand conditions exogenously determined. This assumption can be easily relaxed, and our derivations of exchange rate channels for a short term balance of payments adjustment modified accordingly to reflect short term trade balance elasticities and invoice currency use that relates to rates of exchange rate pass through into traded goods prices.

$$EMP_t = \frac{de_t}{e_t} - \frac{1}{\Pi_e} dR_t - \frac{\Pi_i}{\Pi_e} di_t \tag{7}$$

where

$$\Pi_i^* = \frac{1}{i^*}\left[i^* FA_{t-1} - \epsilon_{i^*}^{FL} FA_t + \epsilon_{i^*}^{FA} \frac{FL_t}{e_t} \right]$$

$$\Pi_i = \frac{1}{i}\left[\frac{FL_{t-1}}{e_t}(i_t - \epsilon_i^{FL}) \frac{FL_t}{e_t} + \epsilon_i^{FA} FA_t \right]$$

$$\Pi_e = i_t \frac{FL_{t-1}}{e_t} + \epsilon_e^{FL} \cdot \frac{FL_t}{e_t} - \epsilon_e^{FA} FA_t$$

where we define elasticities of foreign asset demand and foreign liability supply with respect to exchange rates as $\epsilon_e^{FL}, \ -\epsilon_e^{FA} > 0$, and with respect to foreign rates $\epsilon_{i^*}^{FL}, -\epsilon_{i^*}^{FL} < 0$.

The drivers of the EMP for any country are given by:

$$\begin{aligned} &\frac{de_t}{e_t} - \frac{dR_t}{\Pi_e} - di_t \frac{\Pi_i}{\Pi_e} \\ &= -di_t^* \frac{\Pi_{i^*}}{\Pi_e} - \frac{\frac{1}{e_t} FL'_{s^*}}{\Pi_e} ds_t^* + \frac{FA'_s}{\Pi_e} ds_t - \frac{\frac{1}{e_t} FL'_W}{\Pi_e} dW^* + \frac{FA'_W}{\Pi_e} dW \end{aligned} \tag{8}$$

Exchange market pressure, with its derived weighting structure across quantities of reserves and prices of currency and assets, is highly intuitive. For any given quantity of international capital flows, the equivalency of effects between Home currency depreciation and changes in central bank foreign reserves depends on the set of mechanisms through which exchange rate changes influence international capital flows. Consider the components of Π_e to illustrate the intuition. Given an expected future exchange rate, a depreciation of the Home currency lowers the expected future rate of depreciation and thereby lowers the relative return expected on foreign currency investments. Moreover, a smaller Home exchange rate depreciation is needed to offset capital outflows if investments by home and foreign investors are highly sensitive to uncovered interest parity conditions. An exchange rate depreciation also operates on the balance of payments by reducing the value of payments on foreign liabilities made by Home (assumed for this derivation that the liabilities are denominated in Home currency), thereby providing some extract supportive power for exchange rates in balance of payments adjustment. Thus, the larger is Π_e, the smaller is the exchange rate equivalent of any foreign exchange market pressure that otherwise would need to be reflected in reserves or changes in domestic policy rates.

3.2 Valuation Effects in the Central Bank Reserves Portfolio

In practice, countries have official foreign exchange reserve portfolios comprised of multiple currencies, and the dollar value of foreign exchange reserves may change due to valuation changes of third currencies vis-à-vis USD, without arising from official intervention activity by Home. The possibility of such valuation changes to reserves need to be accounted for in order to avoid erroneous signals in the EMP.[11] Moreover, the balance of payments identity reflects actual flows of official reserves, and does not include changes in reserves due to valuation effects in the foreign official portfolio, as these do not contribute to the adjustment of supply and demand for currencies. Empirically, we only observe $\hat{R}$, which is the value of the total stock of central bank reserves in US dollar equivalents:

$$\hat{R}_t = R_t + \frac{R_t^c}{e_t^c} \tag{9}$$

where R_t^c are reserves held in assets denominated in third country currency (for example, euros). The observed reserve value can change with e_t^c, the bilateral exchange rate between the third currency and the Foreign currency. The third currency may covary with the Home-Foreign exchange rate according to γ:

[11] Below we derive the corresponding adjustments to the EMP, throughout recognizing that the EMP is an appropriate metric of pressure relative to a base or anchor currency instead of relative to a full multilateral exchange rate index.

$$\frac{de^c_t}{e^c_t} = \gamma \frac{de_t}{e_t} + d\tau_t \tag{10}$$

where $cor(\frac{de_t}{e_t}, d\tau_t) = 0$ and an exogenous change $d\tau_t$, which for simplicity is assumed to be uncorrelated with the previously noted drivers of the EMP.[12] Differentiating official reserves and assuming $dR^c_t = 0$, the valuation changes within the reported official reserves are:

$$d\hat{R}_t = dR_t - \frac{R^c_t}{e^c_t}\frac{de^c_t}{e^c_t} = dR_t - \frac{R^c_t}{e^c_t}\left(\gamma\frac{de_t}{e_t} + d\tau_t\right) \tag{11}$$

Equation 11 shows that $d\hat{R}_t$ is a biased estimator of R_t when $\gamma \neq 0$, while $d\tau$ measures the degree of imprecision introduced by independent variation in the third currency.

To build intuition, consider a small country that has a non-trivial amount of official foreign reserves, and holds 30% of these in euro denominated assets and the rest in US dollar assets. Suppose a capital inflow pressure into Home (an initial increase in the demand for Home assets) causes the Home currency to appreciate against the euro as well as the US dollar by 2% (i.e. $\gamma = 0$), with no official interventions. In this case, the value of foreign reserves measured in terms of US dollars does not change, and the EMP picks up the capital inflow pressure correctly as 2%. Suppose instead that the euro also receives inflow pressures and also appreciates, by, say, 1% against the US dollar (i.e. $\gamma = 0.5$). In this case, the value of the Home country's foreign official reserves in US dollar equivalents increases by 0.3%, which in turn increases EMP further through the reserves term, thereby overstating the inflow pressure. Conversely, if the euro instead depreciates against the US dollar by 1% (e.g. if the inflow pressure into Home is due to a sale of euro denominated assets), the EMP understates the capital inflow pressure.

In the case of freely floating currencies, however, this source of bias and noise is easily dealt with, as we would want the EMP to ignore changes in reserves fully. Changes in the value of reserves will not be related to exchange market pressures when the exchange rate is freely floating. This is different when the exchange rate is managed. Consider instead the opposite case of a country that maintains a hard peg against the US dollar. This means that $\frac{de_t}{e_t} = 0$. In this case, the assumption that $d\tau_t$ is unrelated to capital flow pressures made above implies that there is no bias due to valuation in reserves.[13] The EMP will, however, still be affected by shocks to the value of reserves from $\frac{de_t}{e_t} = 0$ that are unrelated to the capital flow pressures, which will be reflected by the EMP as capital flow pressures. In this case, the possibility of such a bias

[12] This assumption is strong. It implies that if a country pegs its exchange rate to the foreign currency, then there is no bias possible due to holdings of reserves in third currencies, only white noise. This assumption should be relaxed in future extensions. Another strong assumption is that γ is a fixed parameter rather than shock-specific.

[13] This strong assumptions can be understood as proxying for the tendency for countries with pegs to hold their majority of reserves in the currency against which they are pegging, which would reduce the potential for valuation effects.

or noise in the index should lead us to reduce the weight that we attach to reserves changes. In intermediate cases, these considerations must be traded off against each other in weighting the reserves term. Exactly how we propose to do this is addressed next.

The above discussion highlights the general point that the relationship between dR and $\frac{de}{e}$ depends on exchange rate regime in place, and we make use of this point for constructing a weighting scheme for the reserves term in the EMP that goes some way toward correcting for valuation fluctuations in reserves. The de facto exchange rate regime, which could be a peg, a fully flexible or an intermediate regime, is distinct from the de jure exchange rate regime (Shambaugh [2004], Ilzetzki et al. [2017]). We allow for any variant by representing the exchange rate regime as a mix of exchange rate movement and intervention activity, such that

$$dR_t = -\rho_R \frac{de_t}{e_t}$$

where ρ_R is the amount of official reserves sales triggered when the domestic currency is facing depreciation pressures. Inserting this relationship in (11), the relevant metric of official reserves changes for the EMP is:

$$\begin{aligned} d\hat{R}_t &= dR_t - \frac{R_t^c}{e_t^c}\left[\gamma \frac{1}{-\rho_R} dR_t + d\tau\right] \\ \Rightarrow dR_t &= \frac{1}{1+\frac{\gamma}{\rho_R}\frac{R_t^c}{e_t^c}} d\hat{R}_t + \frac{\frac{R_t^c}{e_t^c}}{1+\frac{\gamma}{\rho_R}\frac{R_t^c}{e_t^c}} d\tau_t \end{aligned} \tag{12}$$

Inserting into the previously derived expression for the EMP yields a version that appropriately weights the reported change in foreign exchange reserves to adjust for the correlated exchange rate component in the valuation of reserves and for an exogenous uncorrelated component of the portfolio value:

$$\begin{aligned} EMP_t &= \frac{de_t}{e_t} - \frac{1}{\Pi_e} dR_t - \frac{\Pi_i}{\Pi_e} di_t \\ &= \frac{de_t}{e_t} - \Omega_t \frac{d\hat{R}_t}{\Pi_e} - \frac{\Pi_i}{\Pi_e} di_t + \nu_t \end{aligned} \tag{13}$$

where

$$\begin{aligned}
\Omega_t &= \frac{\rho_R}{\rho_R + \gamma \frac{R_t^c}{e_t^c}} \text{ (the weight)} \\
\Pi_e &= i\frac{FL_{t-1}}{e_t} + \epsilon_e^{FL}\frac{FL_t}{e_t} - \epsilon_e^{FA} FA_t \text{ (the scale)} \\
\Pi_i &= \frac{1}{i}\left(i\frac{FL_{t-1}}{e_t} - \epsilon_i^{FL}\frac{FL_t}{e_t} + \epsilon_i^{FA} FA_t\right) \\
\nu_t &= \Omega_t \frac{R_t^c}{e_t^c} d\tau_t
\end{aligned} \tag{14}$$

Note that we cannot easily correct for valuation effects of reserves that are effectively noise (those associated with $d\tau$). Note also that this noise plays a very small to no role in countries with fully flexible exchange rates, as these are weighted to near-zero, but may play a larger role for countries with managed exchange rates.[14] This EMP is fully grounded in the balance of payments and a range of portfolio considerations, combining exchange rate, reserves and interest rate variation in its construction. The scaling of the component pieces is based on foreign assets and liabilities sensitivities to exchange and interest rate changes, with corrections for official portfolio valuation effects. The weight reflects the observed exchange rate regime.

4 Empirical Implementation

We next consider how to translate the model based expression for the EMP into an empirically implementable measure, with the goal of illustrating performance for a large number of countries. The EMP expression that we implement empirically is equation (13) with the terms $\frac{\Pi_i}{\Pi_e} di_t$ and ν_t treated as unobservable error terms, drivers or noise.[15] Constructing the EMP empirically requires a number of choices regarding the data and size of parameters, which we describe in more detail below. The choices we make produce an EMP which we refer to as the baseline EMP in the following. For each of the data and parameter choices, however, there are alternatives that produce alternative empirical EMPs, and we compare some of these alternatives with our baseline in Section 4.5 and appendix to illustrate how sensitive the EMP is to the underlying choices.

Below, we first consider the type of exchange rate to base the empirical EMP on. We next

[14] Our simple model hence shows that the resulting EMP index will have a heteroscedastic error process which depends on the exchange rate regime as captured by Ω, and on the amount of reserves held in third currencies that vary independently with the bilateral exchange rate choice in the EMP construction and reserve portfolio units.

[15] We disregard domestic interest rate movements as a policy response to capital flows, which allows us to avoid hard data choices during the zero lower bound period. Consistently constructed shadow policy rate measures are available only for a small set of countries.

consider how to assess quantitatively the exchange rate elasticities of foreign assets and liabilities that are needed for interaction with gross foreign investment positions in the construction of the scaling factor Π_e, noting that other data and elasticity choices might be appropriate in an application focused on specific countries. Subsequently, we empirically assess the weighting correction for valuation effects, Ω. With these crucial parameters at hand, we present the data and empirically implement the EMP to cover 47 advanced and emerging market countries for about 17 years.

4.1 Exchange Rate Measure

The exchange rate measure that we consider has to capture well the pressures of capital flows, and has to match as closely as possible the currency of denomination of the country's foreign official reserves, so as to minimize the risk of valuation effects that we cannot fully exclude from our measure. Moreover, we want to be able to convert the value of official foreign exchange reserves into this currency, which precludes using indices of effective exchange rates. Based on these criteria, we use the bilateral exchange rate vis-à-vis the main monetary anchor currency of the country in question, as recorded in Klein and Shambaugh [2008] (henceforth KS). For the US and the euro area, which do not have recorded KS anchor currencies, we use the euro and the USD respectively. Most countries in the sample have the USD as KS monetary anchor currency. The exceptions are a number of European non-euro countries, which have the euro as main anchor currency (and the Deutsche mark before the euro), as well as Singapore (The Malaysian bath) and New Zealand (the Australian dollar). The KS classification is available quarterly until the first quarter of 2014. We extrapolate values to 2016 based on this last observation. As an alternative to the baseline of using the KS anchor currency, we also compute the EMP based on the USD for all countries for comparison, and show that the resulting EMP is somewhat sensitive to this choice for countries with non-USD monetary anchor currencies.

4.2 Scaling of Reserves

Empirical measures of the scaling factor Π_e require estimates of the elasticities ϵ_e^{FL} and ϵ_e^{FL}. The empirical literature on the drivers of international portfolio rebalancing generally finds that foreign shares in portfolios respond significantly negatively to an appreciation shock to the exchange rate of the foreign currency (e.g. Hau and Rey [2004], Hau and Rey [2006], Curcuru et al. [2014])). Hau and Rey [2008] find that country portfolio shares within international equity funds fall between 1 percentage-point and 10 percentage-points in response to a 1 percentage-point increase in the excess return of that country's equity (including exchange rate valuation effects). Equity funds may be particularly responsive to changes in returns, however, and a similarly high responsiveness to exchange rate changes is unlikely to characterize the average gross cross-border position. Because of difficulty identifying causality from exchange rate movements to portfolio shares, the previous literature has tended to investigate data on specific types of flows, typically portfolio equity flows at fund level, which allow for more granularity and higher frequency and thus an assessment of the relative timing of exchange rate and capital flow changes. To our knowledge, estimates of the responsiveness of countries' aggregate gross foreign asset and liabilities positions to changes in returns, including exchange rates, are not available.[16]

The previous literature thus suggests that international portfolios rebalance in response to exchange rate changes, but does not provide guidance as to the size of this response for aggregate gross foreign investment positions. Lacking such guidance, we construct a baseline EMP based on an estimated elasticity of 0.05 that we estimate from panel regressions of foreign investment positions for the sample countries that we present and describe in more detail in Appendix (C). Keeping in mind the problems with such regressions and the uncertainty about this number, we consider the sensitivity of the resulting EMP to the size of the applied elasticity in Section 5.1.

For the baseline EMP, we construct the Π_e as denominated in KS monetary anchor currency, so that it matches the denomination of changes in reserves.

4.3 Weighting of Reserves

The weighting scheme that corresponds to the theoretical weight derived in 14 needs to be translated into an empirical equivalent in order to implement the EMP. The first line of expression (14) illustrates that if a central bank manages the exchange rate using foreign exchange interventions, i.e. ρ_R is high, the possible distortion stemming from valuation effects in the foreign official portfolio is small, as Ω would tend toward one. As discussed in Section 4.1, in the case of a highly managed exchange rate against the country's monetary anchor currency, variation stemming from valuation effects in reserves will tend to be outweighed by intervention activity, if the share of reserves held in third currency is small, which is presumably the case with highly managed exchange rates. In contrast, if the central bank does not manage the exchange rate, ρ_R is zero and changes in reserves will tend to reflect of valuation effects, since interventions would not occur in response to capital flow pressures. In intermediate regimes, the extent of the neces-

[16] A separate strain of literature assesses the correspondence between central bank foreign exchange interventions in a pegged system and exchange rate changes in a floating rate system, notably to be used in an alternative exchange market pressure index (Patnaik et al. [2017], or to assess the effectiveness of foreign exchange interventions in affecting the exchange rate (e.g. Menkhoff [2013], Blanchard et al. [2015]). These studies invariably find a positive correspondence between increases in central bank foreign asset holdings in pegged regimes and exchange rate appreciation in a floating regime. The estimated correspondences carry information about net capital flow responsiveness to the exchange rate, but are translated into quantitative proxies for elasticities of gross private foreign investment positions. Patnaik et al. [2017] illustrate how the correspondence varies across countries, and explain this variation with cross country differences in trade, GDP and net FDI stocks as proxies for local currency market turnover.

sary valuation effects correction depends on the share of third currencies held in the central bank portfolio, R^c, as well as the covariation of the exchange rate vis-à-vis the anchor currency and the third currency.[17] If any of these terms are zero, adjusting for valuation effects is inconsequential for the EMP.

As we do not have consistent information across individual countries on the share of reserves held in third currency, we treat this part of Ω as strictly positive and constant across time and countries in the baseline EMP specification. ρ_R cannot be estimated directly because it is not possible to identify causality from the exchange rate to reserve changes in the data.[18] Instead, we proceed based on the observed behavior of the components of the EMP index, which does not require updating information on exchange rate regime classifications when regimes change, or on the identification of causality.[19] When the observed variation in reserves scaled by Π_e is high relative to the observed variation in relative changes in the exchange rate, this is likely to reflect a pegged or managed exchange rate; high variation in changes in the exchange rate relative to the variation in changes in scaled reserves better describes a flexible exchange rate regime. In the extreme case of a hard peg, the variation of changes in the exchange rate will be absent, while variation in changes in foreign reserves constitute the entire variation reflecting pressures on the peg. As most countries exhibit some degree of exchange rate flexibility, many regimes will be best described by a combination of the two. Based on similar observations, Tanner [1999] proposes the ratio of the variance of changes in reserves to the sum of the variances of changes in reserves and changes in the exchange rate as a de facto index of the degree to which a country manages its exchange rate. This reasoning suggests that the adjustment of changes in reserves should be proportional to the relative variation in scaled reserves. We hence propose the following empirical weight for scaled changes in reserves:

$$\tilde{\Omega} = \frac{var\left(\frac{d\hat{R}_t}{\Pi_e}\right)}{var\left(\frac{d\hat{R}_t}{\Pi_e}\right) + var\left(\frac{de_t}{e_t}\right)} \tag{15}$$

$\tilde{\Omega}$ has the property required by theory that if the exchange rate is pegged, there is no valuation adjustment as $\tilde{\Omega} = 1$, while the correction is complete in case of zero variation in reserves and/or very high variation in the exchange rate (in which case we should not pay attention to reserve changes as a reflection of capital flow pressures in the first place).

[17] In our baseline construction, third currencies comprise foreign currencies that are not the KS anchor currency.

[18] Any initial short-lived exchange rate shock may be reduced or reversed completely by successful foreign exchange interventions, in which case we observe the changes in reserves but not the exchange rate change which otherwise would have occurred.

[19] An example of a classification of exchange rate regime is contained in the data set of Klein and Shambaugh [2008].

4.4 Data

Construction of the EMP uses observable data on exchange rates, interest rates, central bank foreign reserves, gross foreign assets, and gross foreign liabilities denominated in foreign currency. The data are drawn from the IMF's International Financial Statistics, International Investment Positions and The Financial Flows Analytics Databases, as well as Bloomberg. To extend the coverage of the data back in time, we use annual values of gross foreign assets and liabilities, interpolated to monthly frequency, in the construction of the Π_e scaling factor. Since the level of gross foreign positions, and not their month-to-month variation, is what matters in the scaling factor, the introduced inaccuracy of interpolating from annual rather than quarterly data to monthly frequency should be minimal. All data sources and definitions are provided in Table 3 in Appendix A. Descriptive statistics for the data are provided in Appendix Table 4 for the unbalanced sample period extending from January 1990 to December 2017 (start and end dates for data vary across countries). The table provides summary statistics for countries sorted into Advanced Economies versus Emerging and Developing economies, consistent with the IMFs country classification.

4.5 The EMP

The computation of the rolling standard deviations used for constructing the weights on reserve changes require the availability of five years of data before the first observation of the EMP can be produced. For countries with data available back to 1990m, the monthly construction of the EMP thus spans 1995m1 through 2016m4. The sample starts later for many countries, however. For consistency across countries, we focus on and present the EMP starting in 2000m1. Because the EMP relies on exchange rate variation, we exclude countries that do not have their own currency. Individual euro area countries are therefore not included in the sample, while the euro area as a whole is. We further include Estonia and Latvia up until their dates of entry into the euro area in January of 2011 and 2014 respectively, but do not include countries that joined the euro earlier.[20]

The descriptive statistics for the baseline EMP and alternative specifications used in the literature are shown in Table 5.[21] We illustrate how this baseline EMP compares with actual net capital flows and the underlying weighting schemes for each individual country in Appendix (E). Throughout, we illustrate the EMPs graphically using quarterly averages, which averages out some of the monthly volatility and make trends more visible. But it is constructed and available in monthly frequency for all sample countries.

[20]For example, we do not include Slovenia and Slovakia, which joined in 2007 and 2009 respectively.

[21]Note that data on interest rates are missing for Nicaragua, and in order to nevertheless include this country in the sample, we have set interest payments in the denominator of Π_e to zero for Nicaragua.

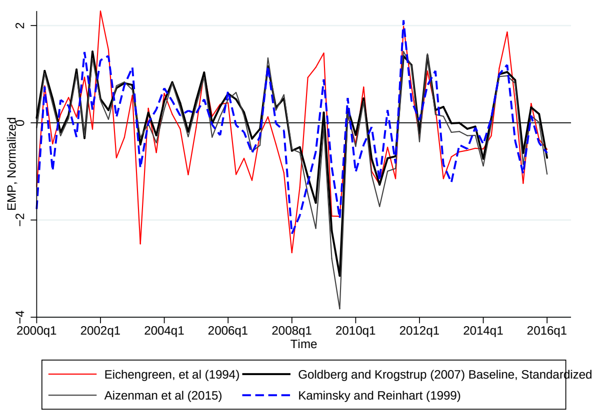
Figure (1) compares the EMP measures proposed in Eichengreen et al. [1994], Kaminsky and Reinhart [1999], and Aizenman et al. [2014b], with our measure (Goldberg and Krogstrup) for four selected countries: South Korea, Switzerland, Brazil, and the United States. For better comparability, we depict the standardized versions of these measures, because their relative amplitudes is arbitrary and result partly from the implicit scaling inherent in the construction of the applied weights.[22] An increase in the EMP denotes a capital outflow pressure (depreciation pressure), and a decrease denotes a capital inflow pressure (an appreciation pressure). Out baseline EMP series depart significantly from the metrics of the prior literature in both the scaling of foreign exchange reserve changes and the weighting of components. Scaling with reserves, as done for example in Kaminsky and Reinhart [1999], tends to overstate fluctuations in reserves when the level of reserves is very small, while this mismeasurement is reduced at larger levels of reserves. The figure illustrates how the different measures differ, at times strong strongly, in both direction and sign. These differences reflect in part the signal to noise ratio of the measurement of reserves changes related to valuation effects, and in part the occasional overweighing of reserves through precision weights.

Differences are particularly strong for the US, where the currency is freely floating and foreign exchange reserves held at the central banks are minimal, and even small fluctuations in reserves can be large in relative terms. In contrast to previous measures, our scaling scheme results in largely zero scaled fluctuations in foreign currency reserves.

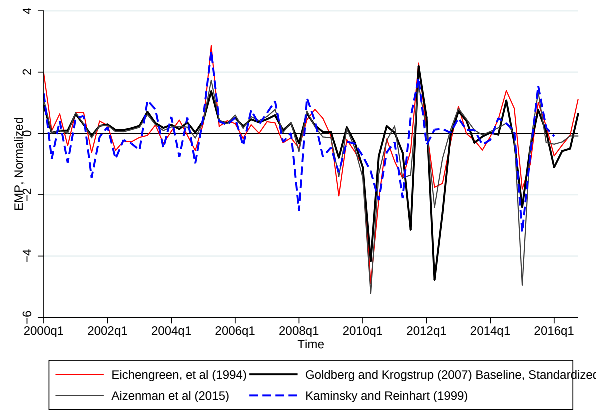
In the case of Switzerland, where the absolute value of foreign currency reserves grew strongly over the sample period, our measure does not amplify the changes in reserves in the early part of the sample period, when reserve levels were still low, but allows for fully capturing the large changes in reserves that took place, at increasingly high levels, in the latter part of the sample.

To illustrate the importance of the choice of anchor currency used for the EMP, Figure (2) compares the baseline EMP for Switzerland and the UK, both countries that have the euro as monetary anchor currency according to Klein and Shambaugh [2008], with the EMP construction based on bilateral exchange rates vis-á-vis the US dollar and US dollar denominated changes in official foreign reserves. The comparison shows that while the anchor currency is important during episodes when exchange rate changes dominate the index, they become less so when reserves changes clearly dominate, as in the case of Switzerland after 2009. The way in which the two versions of the EMP capture capital flow pressures during the height of the financial crisis for Switzerland, moreover, illustrates the relative nature of the EMP as a measure of capital flow pressures. In the last quarter of 2008, the onset of the Global Financial Crisis

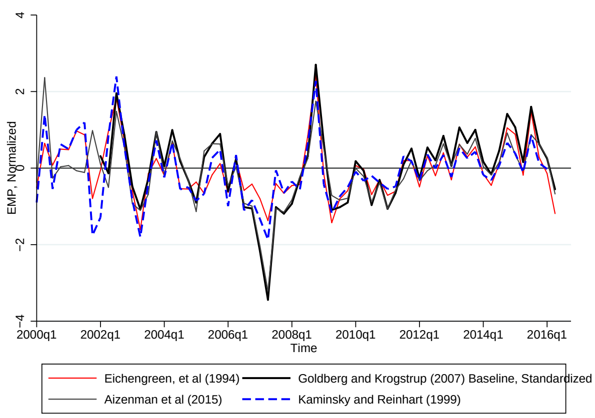
[22]Differences in amplitude are partly due to the partly arbitrary choice of weighting scheme. Our EMP places a weight of one on exchange rate changes, and a weight on reserves changes between zero and one, while precision weights sum to one. This also explains why our EMP is more closely relates to the EMP of Kaminsky and Reinhart [1999], which applies equal weights. Differences are also due to the scaling of reserves changes.



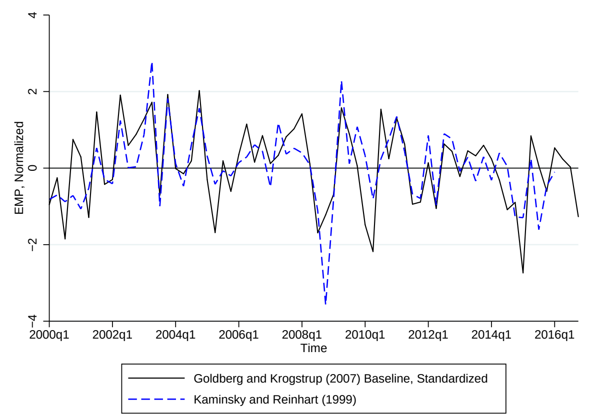
(a) Israel



(b) Switzerland

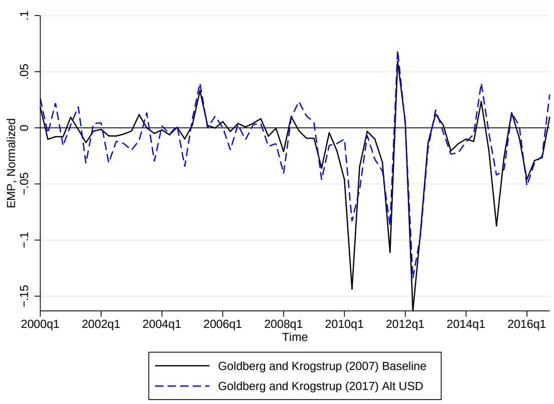


(c) Brazil

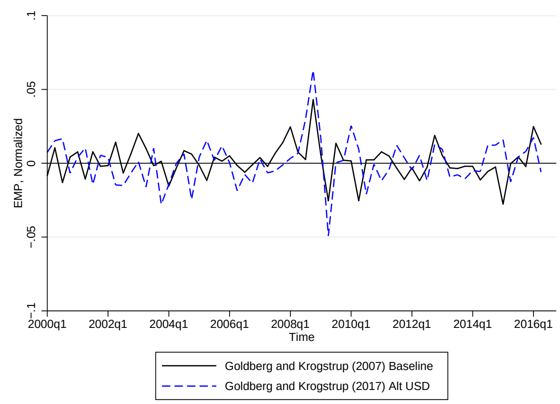


(d) United States

Figure 1: **Baseline EMP and alternatives used in the literature.**
Quarterly averages of monthly values of the EMP, standardized, computed using the methods of Eichengreen et al. [1994], Kaminsky and Reinhart [1999] and Aizenman et al. [2015] as laid out in Table 1, and the baseline Goldberg Krogstrup EMP of expression 8.



(a) Switzerland



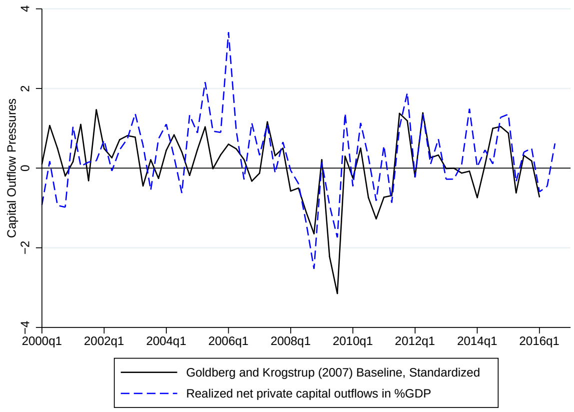
(b) UK

Figure 2: **Baseline EMP and Alternative EMP Based on the USD.**
The baseline EMP for Switzerland is based on the euro as an anchor currency, following Klein and Shambaugh [2008]. The alternative EMP is based on the USD. The EMPs are displayed in quarterly averages of monthly values.

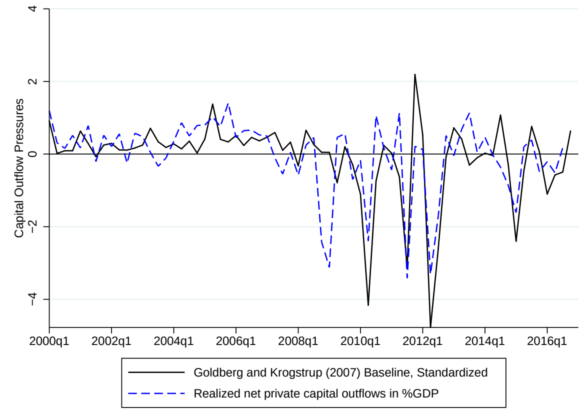
triggered important capital inflow pressures in Switzerland, causing the exchange rate against the euro to appreciate. However, capital inflow pressures into the US dollar were stronger, leading to a net depreciation of the Swiss franc against the US dollar in that quarter. The EMP based on the bilateral rate against the US dollar captures this as a capital outflow pressures, however mild. When the baseline euro exchange rate is used, however, the resulting EMP suggests a mild capital inflow pressures during this episode. Nonetheless, for most episodes and most countries, the two measures are generally consistent with regards to direction of capital flow pressures.

5 Recent Patterns in Capital Flow Pressures

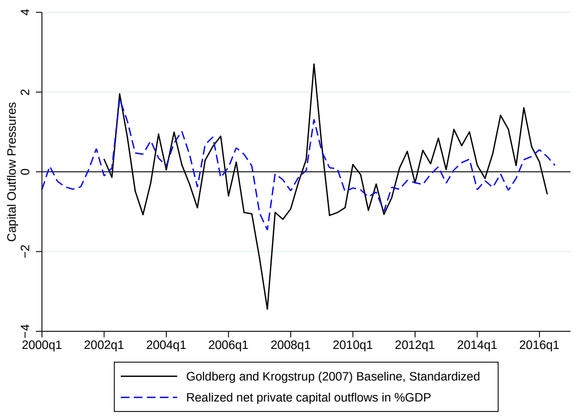
The advantages of the EMP as a measure of net capital flow pressures include its comprehensiveness (i.e. covers all net non-reserve flows), monthly frequency, as well as its comparability across different countries, currency regimes, and over time. Hence, it allows for an assessment of the link between capital flow pressures and global factors at a higher frequency and more consistently across countries than accomplished using realized flow data based on Balance of Payments Statistics and global liquidity series. In this section, we first compare the baseline EMP to realized net capital flows, and subsequently show how it performs in regression specifications typically applied when studying international capital flow and global factors.



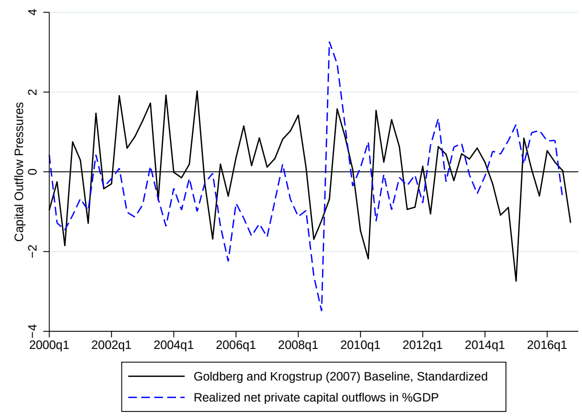
(a) Israel



(b) Switzerland



(c) Brazil



(d) United States

Figure 3: **Baseline EMP and Realized Net Private Capital Outflows.**
Quarterly averages of monthly values of the Goldberg and Krogstrup baseline EMP and net capital outflows in percent of GDP (-$NCAPFLP_GDP$). Both series are normalized by their mean and standard deviation.

5.1 The EMP versus Net Private Capital Flows

Figure (3) compares the baseline EMP with quarterly net private capital inflows in percent of GDP for Israel, Switzerland, Brazil and US, representing different degrees of exchange rate management across both time and countries.

The sign and the direction of change in the EMP and realized net private capital flows are constructed to be directly comparable under the assumptions of the model.[23] The level and amplitude of these two series are not, and they are hence both standardized by country in Figure

[23] An important assumption is that the current account is constant and not responsive to exchange movements. If the current account moves a lot across the sample, this would reduce direct comparability of levels.

(3) to facilitate the comparison.[24] As expected, the degree to which the EMP correlates with actual capital flows depends on the currency regime in place. In countries where the exchange rate is freely floating, capital flow pressures will result in an adjustment of the exchange rate, which in turn feeds back into realized private capital flows. The net effect on realized capital flows depends on elasticities of private capital flows to the exchange rate, as suggested by Equation (8). In contrast, when the exchange rate is highly managed, capital flow pressures materialize fully in a private net capital flow, which is instead accommodated by changes in central bank foreign reserves. Figure (4) illustrates this point more generally with a scatter plot of average GK-Ω weights on reserves, proxying at least to some extent the de facto currency regime, against the country specific correlation of the EMP and actual net private capital flows. Realized private capital flows and the EMP tend to be highly correlated in countries with a high average Ω. The few countries with very low Ω weights invariably exhibit low correlation between the EMP and realized net capital flows. That capital flow pressures, as captured by the EMP, and actual capital flows are more correlated in countries with managed exchange rates, and less so in countries with floating rates, underscores the advantage of using the EMP to measure capital flow pressures in a way that is comparable across exchange rate regimes, and highlights the risk of missing important aspects of capital flow pressures when these are measures by realized capital flows alone.

5.2 The EMP and Global Liquidity Drivers

As the literature on global factors and international capital flows uses published flow data, we test the performance and insights of the EMP as an alternative metric. Equation (8) describes the expected link between the EMP and global financial factors, with these captured by changes in the foreign interest rate differential (di^*), changes in global financial risk sentiment as captured by ds^*, and changes in global financial wealth. Our panel estimating equation is

$$EMP_{t,c} = \beta_i di_{t,c} + \beta_i^* di_t^* + \beta_s ds_t^* + \kappa_c + \varepsilon_{t,c} \tag{16}$$

where c-subscripts denote the country, and κ_c is a country specific fixed effect. The specification focuses on the role of global financial risk sentiment and global interest rates as global factors, which can be measured in monthly frequency.[25] Based on equation (8), we expect a negative sign for β_i and a positive sign for β_i^*, i.e. a lower domestic or a higher foreign interest rate should

[24] For example, if the current account deviated persistently from zero, this would lead to an average net capital flow reflecting the current account which would not constitute a capital flow pressure.

[25] To arrive at specification (16) from equation (8), we make the simplifying assumptions that the terms $\frac{FA'_s}{\Pi_e} ds_t - \frac{\frac{1}{e_t} FL'_W}{\Pi_e} dW^* + \frac{FA'_W}{\Pi_e} dW$ are uncorrelated with the regressors and picked up in country fixed effects and the error term.

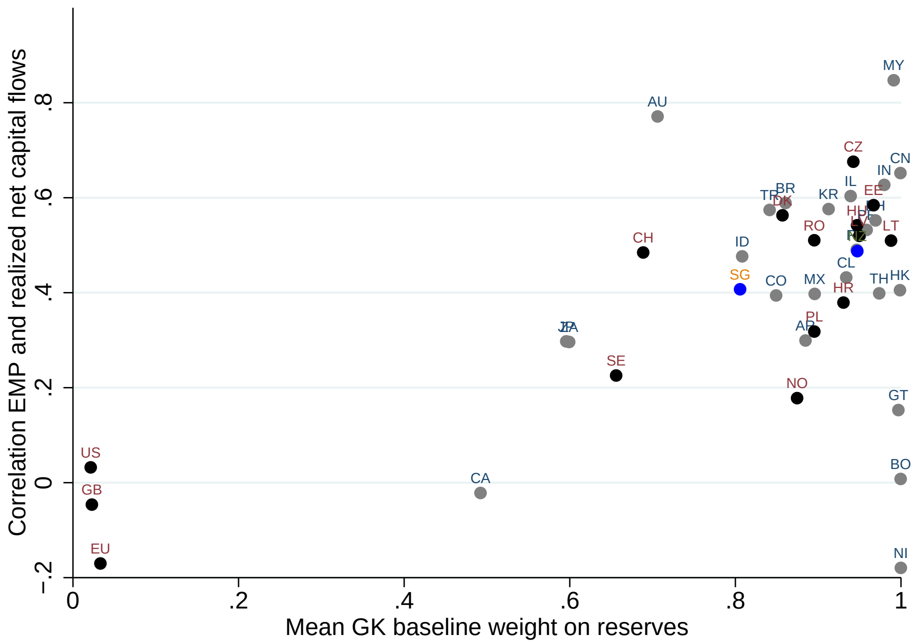


Figure 4: **Baseline EMP Correlations With Flows and Weights on Reserves.** Goldberg-Krogstrup baseline EMP correlation with actual net capital flows by country. Black dots are USD anchor currency countries, gray dots are countries with the euro as anchor currency, and blue dots are countries with third anchor currencies (notably the Malaysian bath and the Australian dollar) according to **?**. Correlations are computed as the simple correlation coefficient of the EMP and net capital outflows based on quarterly data. The sample period is 2000Q1 to 2016Q4. The Ω is the average across the same sample period.

induce capital outflows and thus increase $EMP_{t,c}$, all else equal. The sign for β_s depends on the strength of the elasticities of gross foreign assets and liabilities to increases in risk perceptions. The literature traditionally has found it to be positive for emerging markets, in that risk-off sentiment has been related to outflows, and negative for so-called safe haven countries (Habib and Stracca [2012], Ranaldo and Soederlind [2010]). The size and sign of the parameter estimate as captured by the panel specification (16) will hence reflect the unweighted average of the countries included in the panel and specific time period. Since it is unweigthed, the parameter estimate for the full sample can reflect a net positive association if more countries in the sample experience capital outflow pressures during global risk-off episodes, even though on net, global capital flow pressures appropriately weighted should sum to zero. Section 6 further explores possible country and time variation in βs.

We run a set of simple panel regressions based on specification (16) for three separate country sub-samples, namely emerging markets, so-called safe haven countries and other advanced countries. The literature usually points to at least three currencies with safe haven characteristics, namely the US dollar, the Swiss franc and the Japanese yen. Other currencies have occasionally been associated with safe haven status, but not consistently so, and we hence restrict our safe haven sample to these three countries. For each country sub-sample, we run the regressions for the entire period from 2000m1 to 2016m4, and for three sub-periods, namely the pre-financial crisis period ending with June 2007, the crisis period lasting from July 2007 to June 2009, and the post crisis period beginning in July 2009.

Global financial risk sentiment is measured by fluctuations in the VIX, following prior studies (e.g. Forbes and Warnock [2012], Rey [2015a]), since our focus here is mainly on understanding the performance of the EMP. The foreign interest rate is the rate of the KS anchor currency. Empirical interest rate coefficients may be misleading in the post crisis period because most advanced economies were near the zero lower bound starting in 2009. As a robustness check, we follow Avdjiev et al. [2017] and instead use the shadow policy rate, in this case by Krippner [2016], as it covers the US, UK, Japan, and euro area in the ZLB periods. Moreover, recent research on global financial factors and capital flows brings into question the ability of the VIX to consistently capture global financial risk sentiment over time (Cerutti et al. [2017], Avdjiev et al. [2017], Krogstrup and Tille [2017], Shin [2016]), and as an alternative, we also consider time fixed effects, as discussed further below.

The panel regression results are displayed in columns 1 to 5 in panels (a)-(c) of Table (2) for the three country panels and the different time periods and specifications. The variation explained by the changes in the VIX and interest rates is low, but slightly less so for safe haven countries and in the crisis and post-crisis samples. The effect of the VIX varies across specifications. It is positive for emerging markets and advanced non-safe haven issuers during and after the global financial crisis, suggesting that increases in risk aversion as captured by the VIX was associated, on average, with capital outflow pressures in these country groupings during those time periods. The effects are only statistically significant for emerging markets, however. The change in the VIX is negatively related to capital flow pressures in safe haven countries, although not significantly so. The parameter estimates for interest rates, however, often have the wrong sign and are largely never significant, which may reflect the poor measurement of funding costs since the crisis and the ZLB. Specification 4 using shadow policy rates shows that the foreign interest rate is a significant driver of capital flow pressures in the post-financial crisis period in emerging markets.[26]

As it is notoriously difficult to accurately assess global financial factors as drivers of capital flow pressures empirically, we also follow Cerutti et al. [2017] and capture global common factors indirectly by including time fixed effects in lieu of changes in the foreign interest rate and the VIX. Time fixed effects indiscriminately capture all global factors that affect capital flow pressures in the same way across the panel countries, including the part of the impact of the VIX, the foreign interest rate, foreign financial wealth changes and other possible global factors including real developments, that impact the sample countries in the same way. This allows us to assess how much of the variation in capital flow pressures can be accounted for by common responses to global factors. A time fixed effect does not allow us to assign this global factor to individual types of drivers, however. Moreover, country specific variation not captured by time fixed effects can still be a response to global factors, if this response differs from the response of the average country of the sample. A panel regression restricts the responses of the panel countries to be the same, while Equation (8) makes clear that there is no reason to expect countries to respond in the same way to global factors. Indeed, the fact that safe haven countries have a very different response, as we have shown, is an extreme manifestation of this more general point. We turn to an assessment of individual countries' capital flow sensitivity to global factors in Section (6) below.

The fifth column in the panels of Table (2) presents the results in the full sample including period fixed effects and excluding the VIX and i^*. Time fixed effects substantially increase the share of the variation in the EMP accounted for by the regressors. The share is highest, about 36%, in the safe haven countries. These common global factors explain a substantially larger share of the variation in our measure of capital flow pressures than similarly estimated global factors in regressions on standard capital flow measures in Cerutti et al. [2017]. One reason could be the fact that the EMP accounts for different types of manifestations of pressures (in flows or

[26] Including interaction terms with either capital controls as measured by the Chinn-Ito index, or currency regime using the Klein and Shambaugh [2008] measure of pegs, does not change the share of variation explained in these regressions, and the interaction terms are rarely significant. Not shown, results available upon request.

(a) U.S., Japan and Switzerland

	1. Pre	2. Crisis	3. Post	4. Post (SSR)	5. Full
$dlog(VIX)$	-0.015	-0.040	-0.009	-0.011	
	(0.022)	(0.018)	(0.009)	(0.014)	
di	0.006	-0.020	0.533	0.007	-0.017
	(0.002)	(0.006)	(0.181)	(0.023)	(0.013)
di^*	-0.010*	0.047	0.055*	0.038	
	(0.002)	(0.018)	(0.006)	(0.009)	
R2	0.008	0.193	0.221	0.061	0.357
No.Obs	270	72	254	270	612
No.CS	3	3	3	3	3
FE	Yes	Yes	Yes	Yes	Yes
PE	No	No	No	No	Yes

(b) Advanced Economies excl. U.S., Japan and Switzerland

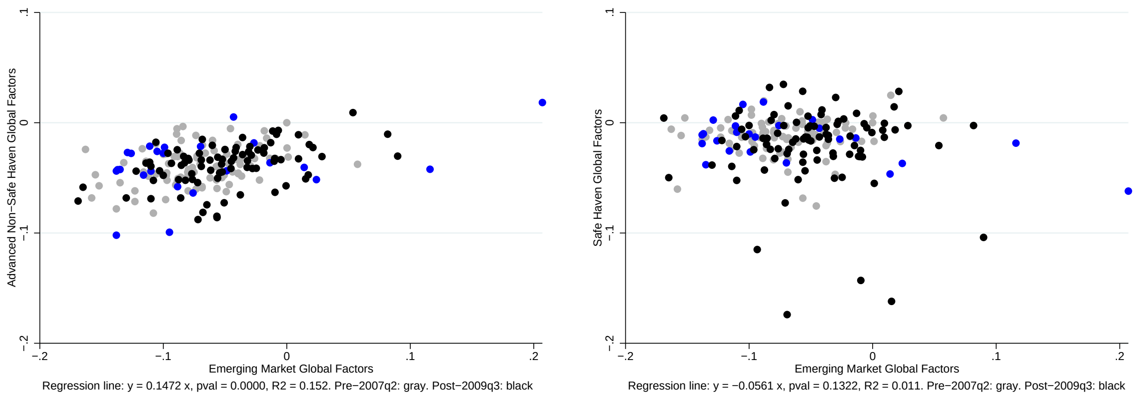
	1. Pre	2. Crisis	3. Post	4. Post (SSR)	5. Full
$dlog(VIX)$	-0.027	0.041	0.020	0.020	
	(0.015)	(0.038)	(0.014)	(0.014)	
di	-0.011	-0.016	-0.009	-0.011	-0.014
	(0.007)	(0.011)	(0.009)	(0.008)	(0.008)
di^*	0.010	0.005	-0.010	0.009	
	(0.009)	(0.010)	(0.015)	(0.005)	
R2	0.013	0.027	0.011	0.014	0.145
No.Obs	810	216	737	737	1763
No.CS	10	9	9	9	10
FE	Yes	Yes	Yes	Yes	Yes
PE	No	No	No	No	Yes

(c) Emerging Markets

	1. Pre	2. Crisis	3. Post	4. Post (SSR)	5. Full
$dlog(VIX)$	-0.040*	0.140***	0.077***	0.081***	
	(0.015)	(0.031)	(0.013)	(0.013)	
di	-0.000	-0.002	0.007	0.007	0.000
	(0.000)	(0.009)	(0.004)	(0.004)	(0.000)
di^*	-0.032	-0.026	0.030	0.033**	
	(0.017)	(0.020)	(0.044)	(0.009)	
R2	0.003	0.034	0.023	0.033	0.125
No.Obs	2695	786	2486	2486	5967
No.CS	34	33	33	33	35
FE	Yes	Yes	Yes	Yes	Yes
PE	No	No	No	No	Yes

Table 2: EMP **Panel Regression Results**

Results from monthly panel regressions of equation (16). i^* is the euro area rate for countries with the euro as anchor currency, and the US interest rate otherwise. The full sample is from 2000m1 to 2016m12, the pre-crisis sample stops in 2007m6, the crisis sample runs from 2007m7 to 2009m6 and the post crisis sample runs from 2009m7 to 2016m4. FE indicates country fixed effects and PE indicates period fixed effects. No. CS gives the number of included cross sections. The fourth column uses Krippner's shadow policy rates for the US, the euro area, Japan and the UK. The final column includes period fixed. Clustered standard errors are shown in parentheses. Asterisks *, ** and *** indicate significance at the 10, 5 percent and 1 percent levels.



(a) EMs vs Non-safe haven AEs

(b) EMs vs. Safe Haven AEs

Figure 5: **Global Factors Proxied By Panel Time Effects**
Global factors for non-safe, as measured by the time fixed effects from panel regressions of the EMP on time and country fixed effects and first differences of domestic interest rate (Columns V is Table 2.

prices) instead of exclusively in outright flows.

We find that the global factors for emerging markets and advanced economies are positively and significantly correlated, while safe haven global factors are negatively correlated with emerging markets, however not significantly so. The upper left hand panel in Figure (5) presents a scatter plot of the time fixed effects for these two country groupings.[27] Panel (b) on the other hand shows the global factor for emerging markets against that of safe havens. The association is negative, but less significant (a similar picture would emerging safe haven global factors were plotted against non-safe haven advanced economies, not shown). Interesting observations are that the size range of global factors for emerging markets is widest, that the advanced non-safe haven global factors are smaller during the crisis period, and that the strength of the effects on the EMP is largely in the appreciation space pre-crisis, while more mixed post crisis.

6 The GRR: Country Specific Global Factor Sensitivities

The role played by global factors in driving capital flow pressures estimated above represent unweighted average effects across countries. The restriction of joint parameter estimates across countries inherent in the panel approach neglects the information in the data about differences in the sensitivities of capital flow pressures to global factors across countries. Country specific sensitivities are relevant for assessing the nature of a country's exposure to shifts in global factors. It ties into the literatures on global monetary policy spillovers and policy trade-offs for emerging markets (Rey [2015b], Obstfeld et al. [2017]) and the challenges of capital flow pressures for safe

[27]The global factors are derived from the regressions presented in columns 5 in Table (2).

asset providers and safe havens (Gourinchas and Rey [2016], Habib and Stracca [2012], Ranaldo and Soederlind [2010]). Indeed, our derivation of the expected size and sign of the correlation between capital flow pressures captured by the EMP on the one hand, and global factors captured by i^*, s^* or W^* on the other, shown by equation 8, are expected to be country specific. We illustrate how the EMP can be used to assess the country specific sensitivities empirically by honing in on the global financial sentiment factors as captured by s^* in equation (8), and proposing and computing an empirical Global Risk Response index (the GRR) as the time varying empirical correlation of monthly changes in the global factor s^* with the monthly country and time specific baseline EMP. Specifically, the $GRR_{t,c}$ is the country specific partial correlation coefficient between the $EMP_{t,c}$ and the global factor based on country specific regressions of expression 16, in which we have standardized all variables by their sample mean and standard deviation, so as to make the regression coefficients directly comparable across countries.

The $GRR_{t,c}$ reflects the degree to which exchange market pressures are driven by global financial shocks rather than other shocks during a specified time period (the regression sample period) before time t. The GRR takes values between -1 and 1. The closer the $GRR_{t,c}$ is to 1 in absolute terms, the stronger is global financial risk as the main driver of exchange market pressures relative to other drivers (such as interest rates that we directly control for, and other factors that enter the error term), relative to the anchor currency. The sign of the $GRR_{t,c}$ contains information on the direction of the correlation. If the GRR is positive, capital outflow pressures increase relative to the anchor currency when the VIX increases. If the GRR is negative, a risk-off event tends to be associated with relative capital inflow pressures.

It is important to stress the relative interpretation the index. Given that the baseline EMP is a measure of capital flow pressures relative to the anchor currency, and hence the anchor currency country, the GRR should also be interpreted as the capital flow pressure sensitivity relative to that of the anchor country. A positive sign thus does not necessarily mean that higher risk aversion is associated with absolute capital outflow pressures, but rather that it is associated with more outflow pressures than what the anchor country is experiencing. The significance of the $GRR_{t,c}$ indicates a deviation in the pattern from that of the anchor country, rather than the absolute sensitivity of capital flow pressures to global risk factors.

We illustrate the $GRR_{t,c}$ using the VIX as a measure of s^*, but stress that the VIX can be substituted with any global risk measure of choice available in monthly frequency.[28] The GRR based on five year rolling windows is presented in the appendix Figures (12) for each sample country. For countries that have data availability that allows for construction of the EMP starting in 1995m1, the $GRR_{t,c}$ can be produced starting in 2000m1 given a rolling window of

[28] In robustness tests not shown, we computed the GRR using alternative regional implicit stock volatility measures, with very similar results (not shown).

five years. For most countries, however, the $GRR_{t,c}$ will start later.[29]

Figure (6) compares the $GRR_{t,c}$ computed using the pre-crisis sample period to that based on the short crisis period and the post crisis periods. All three figures are sorted according to the size of the $GRR_{t,c}$ during the post-crisis period. These exhibits show substantial difference between the sensitivities as well as the relative rankings of countries implied by the pre and post crisis samples. Significant $GRR_{t,c}$ are rare in the pre-crisis sample, consistent with the results of the panel regressions in Section (4). The size of the $GRR_{t,c}$s in the bottom of the ranking increased strongly from the pre-crisis period to the crisis and post crisis periods, suggestive of a greater sensitivity of many countries to global factors after the crisis. This is also evident from the country charts of rolling $GRR_{t,c}$s presented in the appendix. Mexico and China stand out as having particularly elevated sensitivities to global factors post crisis.

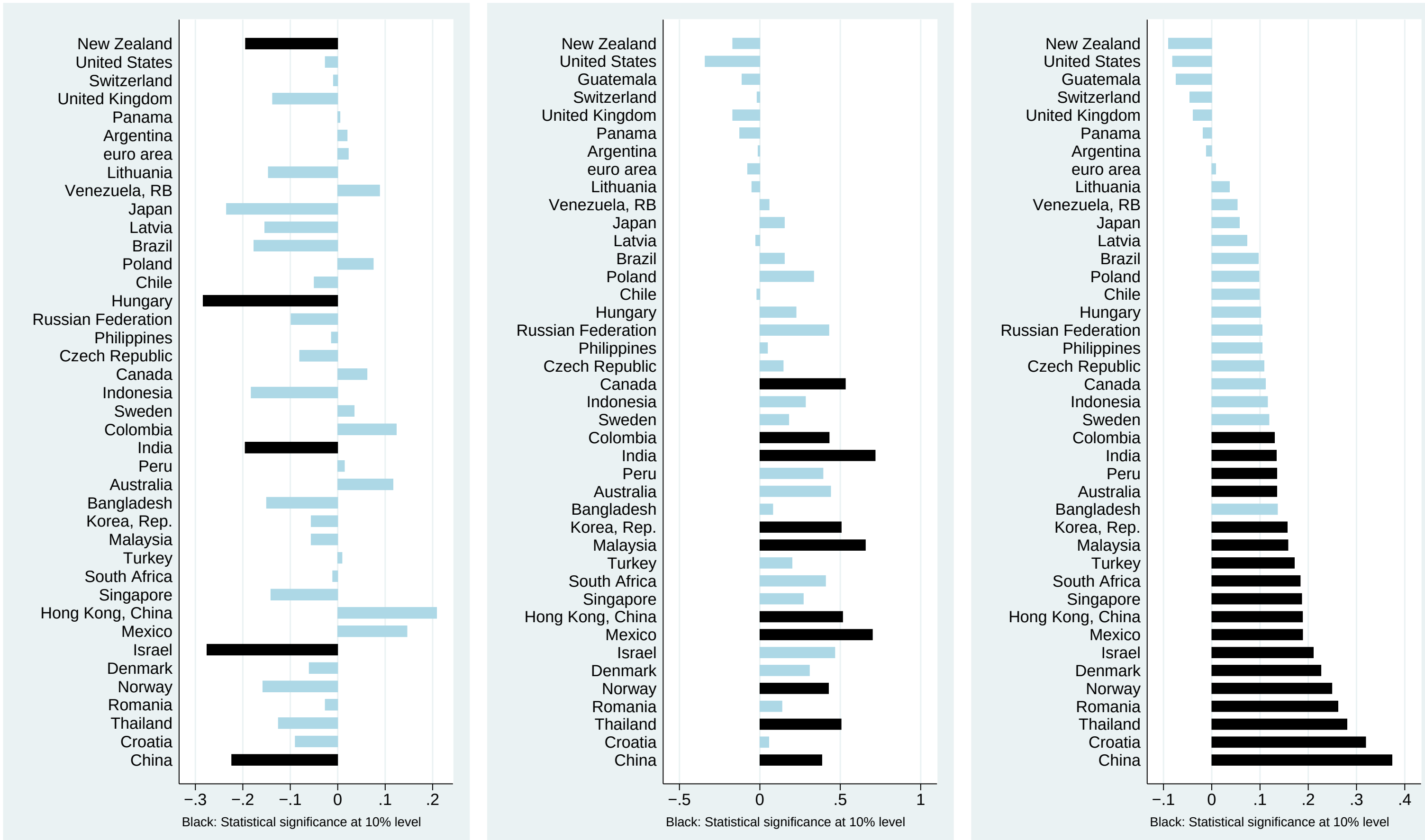
Second, some surprising countries appear in the top part of the list with negative $GRR_{t,c}$s. Small open financial centers feature in the upper part of the ranking, with the exception of Hong Kong. Moreover, Argentina and Guatemala feature near the top, raising questions as to the drivers of these sensitivities, and possibly, the role of capital controls in muting relative sensitivities. Whether these findings are specific to the VIX as a measure of global risk is left for future research.

Finally, the rankings do not reflect any clear dichotomy between advanced and emerging markets in terms of their capital flow sensitivities to global factors. Both types of countries are present in both ends of the rankings in all periods. And the country specific sensitivities have changes across the three sample periods, with the pre-crisis ranking very different to the post-crisis ranking.

7 Conclusions

This paper has proposed a new measure of capital flow pressures in the form of an exchange market pressure index. While exchange market indices have a long tradition, our approach provides a solid grounding in international financial theory and balance of payments conditions. The metric takes seriously the form of exchange rate regime in place at each point in time, the level and composition of the foreign exchange reserve portfolio, and the drivers of gross foreign asset and liability positions at the country level. The advantages of this index over the use of data on actual flows are that it can be computed for a broad panel of countries and over time, that it offers monthly variation in capital flow pressures, that it can be computed with only a few months of lag, and that it takes into account actual flows as well as incipient capital flow

[29]The $GRR_{t,c}$ cannot be computed for Sri Lanka, which does not have enough data to produce 5-year rolling correlations.



(a) Pre-Crisis Period (b) Crisis Period (c) Post-Crisis Period

Figure 6: GRR**s for Selected Sample Periods**

The $GRR_{t,c}$ presented here is the partial correlation coefficient from regressions of monthly standardized values of the baseline EMP and the $dlog(VIX)$, also controlling for changes in domestic and foreign interest rates, over the specified sample period. The pre-crisis sample runs from 2000m1 to 2007m6, the crisis sample runs from 2007m7 to 2009m6, and the post-crisis sample runs from 2009m7 to 2016m4. Correlations significantly different from zero at a 90% confidence level are marked by black bars.

pressures that result in exchange rate changes rather than actual flows. Disadvantages are that the index must be constructed and relies on some baseline parameters, with associated scope for mismeasurement. The baseline country examples based on monthly data from years 1990 through 2016 demonstrate the value of the EMP for countries spanning a range of exchange rate regimes.

To illustrate the use of the EMP, this paper has also proposed the Global Risk Response index, capturing the country specific correlation of the measure of foreign exchange market pressure with a global risk proxy. Empirical exploration using the $GRR_{t,c}$ demonstrates that countries' capital flow response to global risk varies across time as well as across currencies. The sensitivity of capital flows to global risk aversion has increased over the past decades, and in particular since the global financial crisis. Some countries have seen an increase in capital inflow pressures as risk aversion increases, while other countries have experienced an increase in their capital outflow pressures during risk-off episodes. This general finding coexists with substantial variation, both over time and across countries, in both the size and sign of the response of capital flows to global risk aversion. So called "safe-haven" status is by no means immutable. Important questions remain on what drives the response of global capital flows to risk aversion across both time and countries. The new metrics presented in this paper should facilitate further explorations.

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A Data Sources and Definitions

Variable	Data	Source	Definition
e:	Baseline exchange rate defined as the bilateral exchange rate vis-à-vis KS anchor currency	Own calculations based on IMF International Financial Statistics and Klein and Shambaugh [2008]	Bilateral exchange rate in end of period, monthly frequency. KS anchor currency is available yearly until 2014Q1. In domestic per KS currency units. Interpolated to monthly frequency and extrapolated to 2016.
e_{USD}	Bilateral exchange rate against the USD	IMF International Financial Statistics	In domestic currency per USD. End of period, monthly
$reer$	Real effective exchange rate	IMF International Financial Statistics	Defined such that an increase denotes a depreciation of the domestic currency. Monthly
R	Official foreign exchange reserves (total reserves minus gold) converted into KS anchor currency equivalents	Own calculations based on IMF International Financial Statistics and Klein and Shambaugh [2008]	In billions of KS currency equivalents. In billions of KS anchor currency units, end of period, monthly. KS anchor currency is available yearly until 2014Q1. Interpolated to monthly frequency and extrapolated to 2016.
R_{USD}	Official foreign exchange reserves (total reserves minus gold)	IMF International Financial Statistics	In billions USD, end of period, monthly.
i	Domestic monetary policy or short-term rate	IMF International Financial Statistics. Data missing for Nicaragua.	In percentage points, end of period, monthly.
i^*	Baseline foreign interest rate defined as the interest rate i of the country's KS monetary anchor currency.	Own calculations based on IMF International Financial Statistics and Klein and Shambaugh [2008]	In percentage points, end of period, monthly. KS anchor currency is available yearly until 2014Q1. Interpolated to monthly frequency and extrapolated to 2016.
i_{SSR}	Shadow policy rate in the US, EU, Japan and UK	Krippner [2016]	In percentage points, end of period, monthly.
i^*_{SSR}	i^* where the foreign interest rate has been replaced by the i_{SSR} for the US and EU when the USD and the euro are the KS monetary anchor currencies	IMF International Financial Statistics, Krippner [2016] and Klein and Shambaugh [2008]	In percentage points, end of period, monthly. KS anchor currency is available yearly until 2014Q1. Interpolated to monthly frequency and extrapolated to 2016.
GDP	Gross domestic produced in USD	IMF International Financial Statistics	Quarterly
$M1$	Narrow monetary aggregate in billions USD	IMF International Financial Statistics	End of period, monthly
VIX	The VIX	Bloomberg	End of period, monthly
FA	Total Foreign Assets less FDI in KS currency equivalents	Own calculations based on IMF International Investment Positions and Klein and Shambaugh [2008]	In billions of KS anchor currency units. KS anchor currency is available yearly until 2014Q1. Interpolated to monthly frequency and extrapolated to 2016. End of period, yearly, interpolated to monthly frequency.
FL	Total Foreign Liabilities less FDI in KS currency equivalents	Own calculations based on IMF International Investment Positions and Klein and Shambaugh [2008]	In billions of KS anchor currency units. KS anchor currency is available yearly until 2014Q1. Interpolated to monthly frequency and extrapolated to 2016. End of period, yearly, interpolated to monthly frequency.
FA_{USD}	Total Foreign Assets less FDI	IMF International Investment Positions	In billions USD. End of period, yearly, interpolated to monthly frequency (quarterly frequency used in regressions Appendix (C)).
FL_{USD}	Total Foreign Liabilities less FDI	IMF International Investment Positions	In billions USD. End of period, yearly, interpolated to monthly frequency and converted using bilateral exchange rate. Quarterly frequency is used in regressions in Appendix (C).
$NCAPFLP\_GDP_{USD}$	Net private capital inflows in percent of GDP	IMF Financial Flows Analytics (FFA) database	In percent, quarterly.

Table 3: Data Sources and Definitions

KS anchor currency is the currency listed as the country's main monetary anchor currency by Klein and Shambaugh [2008]. Data are collected from January 1990 to December 2016. Descriptive statistics are listed in Table 4 below.

	Mean	Max	Min	Std. Dev	Obs
Advanced					
$\frac{de}{e}$	0.000	0.105	-0.083	0.019	1063
$\frac{de\_USD}{e\_USD}$	-0.000	0.117	-0.082	0.023	1063
$\frac{dreer}{reer}$	-0.000	0.090	-0.067	0.017	1063
dR	0.660	60.292	-21.865	4.675	1063
dR_USD	0.750	69.086	-21.865	4.842	1063
di	-0.043	1.857	-6.000	0.312	1063
di^*	-0.021	0.500	-0.875	0.195	1063
di_ssr	-0.038	2.869	-6.000	0.355	1063
di_ssr^*	0.016	1.562	-1.051	0.347	1063
GDP	2691.518	18325.200	49.860	4238.457	1063
$M1$	960.944	7563.057	4.616	1644.962	1063
FA	2470.190	15970.885	30.845	3633.535	1063
FL	2752.454	23181.070	42.754	4399.218	1063
FA_USD	2981.955	17584.400	23.858	4655.511	1063
FL_USD	3346.344	25413.600	49.205	5668.471	1063
Emerging					
$\frac{de}{e}$	0.005	0.766	-0.126	0.031	1884
$\frac{de\_USD}{e\_USD}$	0.004	0.766	-0.126	0.033	1884
$\frac{dreer}{reer}$	0.000	0.443	-0.233	0.027	1884
dR	1.221	109.619	-81.125	7.535	1884
dR_USD	1.023	109.619	-81.125	7.023	1884
di	-0.158	102.200	-319.080	8.403	1884
di^*	-0.013	0.250	-0.875	0.200	1884
di_ssr	-0.158	102.200	-319.080	8.403	1884
di_ssr^*	0.034	1.562	-1.051	0.358	1884
GDP	488.584	10759.080	4.800	1054.421	1884
$M1$	137.406	5554.767	0.437	530.915	1884
FA	398.967	10058.475	-321.635	1124.561	1884
FL	286.990	5849.867	-405.266	649.301	1884
FA_USD	284.875	5555.660	-321.635	654.677	1884
FL_USD	216.256	2236.450	-405.266	312.026	1884

Table 4: Data Sample and Descriptive Statistics

The variables included in the data set and described here are further defined and sources are given in data appendix table (3). The data are in monthly frequency and span January 1990 to December 2016. Gross foreign positions are interpolated from yearly frequency (quarterly frequency of the gross foreign positions are used for the regression in Appendix (B)). GDP is interpolated from quarterly frequency. Net private capital inflows in percent of GDP are not included in the table as these are used only in quarterly frequency for comparison with averaged EMP measures. The top part of the table contains statistics for the sample of advanced economies and the bottom part contains statistics for the sample of emerging markets and developing countries. 47 countries are included in the sample, of which 16 are advanced economies (Australia, Canada, Denmark, Estonia, Israel, Japan, Latvia, New Zealand, Norway, Slovenia, Slovakia, Sweden, Switzerland, United Kingdom, United States and the euro area), and 31 are emerging markets and developing countries (Argentina, Bangladesh, Bolivia, Brazil, Chile, China, Colombia, Croatia, Czech Republic, Guatemala, Hong Kong, Hungary, India, Indonesia, Republic of Korea, Lithuania, Malaysia, Mexico, Nicaragua, Panama, Peru, Philippines, Poland, Romania, Russian Federation, Singapore, South Africa, Sri Lanka, Thailand, Turkey and Venezuela).

	Mean	Max	Min	Std. Dev	Obs
1_SafeHavens					
Baseline Goldberg Krogstrup	-0.008	0.139	-0.403	0.044	585
Goldberg Krogstrup vis-a-vis USD	-0.008	0.143	-0.380	0.040	585
Kaminsky Reinhart (1999)	-0.002	0.084	-0.080	0.014	585
Eichengreen et al. (1994)	-0.002	0.077	-0.132	0.012	585
Aizenman et al. (2015)	-0.001	0.053	-0.108	0.009	585
2_Advanced					
Baseline Goldberg Krogstrup	-0.004	0.388	-0.376	0.055	1734
Goldberg Krogstrup vis-a-vis USD	-0.005	0.360	-0.376	0.057	1734
Kaminsky Reinhart (1999)	-0.001	0.144	-0.088	0.018	1734
Eichengreen et al. (1994)	-0.001	0.204	-0.106	0.020	1734
Aizenman et al. (2015)	-0.001	0.117	-0.071	0.007	1734
3_Emerging					
Baseline Goldberg Krogstrup	-0.034	1.153	-1.486	0.147	4704
Goldberg Krogstrup vis-a-vis USD	-0.034	1.153	-1.519	0.150	4704
Kaminsky Reinhart (1999)	-0.003	0.458	-0.187	0.021	4704
Eichengreen et al. (1994)	-0.002	0.414	-0.105	0.024	4704
Aizenman et al. (2015)	-0.001	0.077	-0.051	0.007	4704
Total					
Baseline Goldberg Krogstrup	-0.024	1.153	-1.486	0.125	7023
Goldberg Krogstrup vis-a-vis USD	-0.024	1.153	-1.519	0.127	7023
Kaminsky Reinhart (1999)	-0.002	0.458	-0.187	0.020	7023
Eichengreen et al. (1994)	-0.001	0.414	-0.132	0.022	7023
Aizenman et al. (2015)	-0.001	0.117	-0.108	0.007	7023

Table 5: Descriptive Statistics for different EMPs

The baseline Goldberg-Krogstrup baseline and EMPs and the version vis-a-vis the USD are described in Sections 4. The expressions for the EMPs based on Eichengreen et al. [1994], Kaminsky and Reinhart [1999] and Aizenman et al. [2015] are summarized in Table 1. The table provides descriptive statistics for the measures computed for the time period from 2000m1 to 2016m4 divided on safe haven countries, advanced non-safe havens and emerging markets.

B Exchange Rate Elasticities Definitions

The elasticities of foreign assets and foreign liabilities to the exchange and interest rates can be derived from equations 3 and 4:

$$
\begin{aligned}
\epsilon_e^{FA} &= \frac{\partial FA}{\partial e}\frac{e_t}{FA_t} = \left[\frac{W_t}{e_t}(-\alpha'_{uip}\frac{E(e)}{e_t^2}) - (1-\alpha)\frac{W_t}{e_t^2}\right]\frac{e}{(1-\alpha)\frac{w_t}{e_t}} \\
&= \left[-\alpha'_{uip}\frac{E(e)}{e_t} - (1-\alpha)\right]\frac{1}{1-\alpha} = -\left[\frac{\alpha'_{uip}}{1-\alpha}\frac{E(e)}{e_t} + 1\right] < 0 \\
\epsilon_e^{FL} &= \frac{\partial FL}{\partial e}\frac{e_t}{FL_t} = \left[e_t W_t^*(\alpha^*_{uip}\frac{E(e)}{e_t^2}) + (1-\alpha^*)W_t^*\right]\frac{e_t}{(1-\alpha^*)e_t W_t^*} \\
&= \left[\frac{\alpha^*_{uip}}{1-\alpha^*}\frac{E(e)}{e_t} + 1\right] > 0 \\
\epsilon_i^{FA} &= \frac{\partial FA^*}{\partial i}\frac{i_t}{FA_t} = \frac{W_t}{e_t}(-\alpha_{uip})\frac{i_t}{(1-\alpha)\frac{W_t}{e_t}} \\
&= -\frac{-\alpha_{uip}}{1-\alpha}\cdot i < 0 \\
\epsilon_i^{FL} &= \frac{\partial FL^*}{\partial i}\frac{i_t}{FA_t} = e_t W_t^*(\alpha^*_{uip})\frac{i_t}{(1-\alpha^*)e_t W_t^*} \\
&= \frac{\alpha^*_{uip}}{1-\alpha^*}\cdot i_t > 0 \\
\epsilon_{i^*}^{FA} &= -\epsilon_i^{FA} \text{ and } -\epsilon_{i^*}^{FL} = -\epsilon i^{FL}
\end{aligned}
$$

C Exchange Rate Elasticities from Panel Regressions

This appendix presents a panel regression of foreign assets and liabilities positions on exchange rates, with the aim of assessing the size of the elasticity of foreign investment positions to exchange rate changes, and discussed in Section (4.2).

Estimating the response of capital flows to the exchange rate is complicated because of the endogeneity of capital flows and exchange rates to each other as well as to the exchange rate regime in place in the country in question. For example, we would expect an exchange rate appreciation to initially cause a capital outflow as international portfolios rebalance. However, we would expect a capital outflow shock to cause an exchange rate depreciation, or foreign exchange interventions (see also Klaassen [2011]). We only observe the equilibrium outcome for flows and the exchange rate, but not the partial responses that we are interested in assessing. We attempt to address these issues with a panel regression analysis of gross capital flows that produces empirical estimates of $\epsilon_e^{j,FA}$ and $\epsilon_e^{j,FA}$, based on equations (3) and (4). In this setup, endogeneity would tend to bias the estimates of the capital flow response to the exchange rate downward. Thus, if we find the right signs, we should be capturing the direction qualitatively and gain insight into the lower bound for the size of the response.[30] To reduce the endogeneity bias, we lag all explanatory variables by one quarter, keeping in mind that lagging may not fully address concerns in case of persistence in the regression variables. Allowing an exchange rate shock to affect capital flows over the following three months is consistent with the timing of the effect estimated in Hau and Rey [2004].

With a broad panel of countries, the country specific variation in the exchange rate depends on the exchange rate regime. Countries with hard pegs, such as Hong Kong, will have minimal exchange rate variation, effectively preventing empirical measurement of the impact of exchange rate variation on private capital flows.[31] For this reason, we estimate the regression as a panel and impose the restriction that the elasticity of gross positions to the exchange rate is the same across groups of countries, as further discussed below. The panel approach allows us to produce predictions for exchange rate elasticities for countries that do not exhibit sufficient variation in the exchange rate to estimate the country specific elasticity. The panel approach also allows us to control for variation in gross positions due to common global shocks by including time fixed effects.

It is possible that the average elasticities of international investment positions depend on the composition of gross foreign asset and liabilities (e.g. Cerutti et al. [2015]), which may change over time. It is beyond the scope of this paper to estimate elasticities individually for all sub-items of international investment positions. As a short-cut, we exclude foreign direct investments (FDI) from the gross foreign investment positions. The share of FDI in gross positions has grown strongly in recent years (Milesi-Ferretti and Lane [2017]), but this type of investment is less likely to respond to exchange rate changes.[32] Portfolio and bank related international investment positions are more likely to be responsive to changes in prospective returns, absent capital controls.

Global financial factors such as US monetary policy, risk aversion and global liquidity and financial wealth accumulation are clearly of importance in driving global capital flows and should be controlled for, but these variables are very difficult to correctly measures empirically, in particular since the advent of the ZLB period.[33] Since such factors are not the focus of this exercise, we instead control for all common global factors in the variation

[30] A downward bias in the elasticities would increase Π_e and hence place too high a weight on reserves changes relative to exchange rate changes in the modified EMP.

[31] Patnaik et al 2017 face a similar problem and carry out estimations only for countries where variation allows for identification of the parameter they are focusing on. They then use the estimation equation to predict the parameter estimates for the countries that do not have sufficient variation to allow direct estimation, based on the characteristics that turn out to matter for the size of the parameter estimate.

[32] A further refinement of the approach would be to exclude long-term bank positions, if these could be consistently identified in the data.

[33] Avdjiev et al. [2017] consider such factors as drivers of capital flows explicitly.

	$dlog(FA)$		$dlog(FL)$	
	I	II	III	IV
$dlog(e)$	−0.052**	−0.039	−0.006	0.033
$dlog(e) \cdot EM$		−0.037		−0.103**
$d(i)$	0.008***	0.007***	0.0003	−0.0006
$d(i) \cdot EM$		0.001		0.003
$dlog(GDP)$	−0.041	0.067**	−0.041	−0.023
$dlog(GDP) \cdot EM$		−0.048		−0.041
R^2	0.48	0.48	0.20	0.20
No. Obs	1969	1969	1981	1981
No. countries	49	49	49	49

Table 6: **Regression Results for Gross International Investment Positions**
Results for estimating regression equations (17) and (18). All specifications contain time and fixed effects (not shown). Regressions are based on quarterly data from 2000Q1 to 2016Q4 excluding the financial crisis quarters between 2008Q3 and 2009Q2. Asterisks *, ** and *** indicate significance at the 10, 5 percent and 1 percent levels, respectively, using clustered standard errors.

by including time effects in the regressions. We control for country specific time invariant effects by including country fixed effects. Finally, growth in local wealth is approximated by local GDP growth. The estimating equations become:

$$dlog(FA_t^j) = \epsilon_e^{c,FA} dlog(e_{t-1}^j) + \epsilon_i^{c,FA} d(i_{t-1}^j) + \epsilon_w^{c,FA} dlog(GDP) + \varphi^j + \tau_t + \varepsilon_t^j \tag{17}$$

$$dlog(FL_t^j) = \epsilon_e^{c,FL} dlog(e_{t-1}^j) + \epsilon_i^{c,FL} d(i_{t-1}^j) + \epsilon_w^{c,FL} dlog(GDP) + \varphi^j + \tau_t + \varepsilon_t^j \tag{18}$$

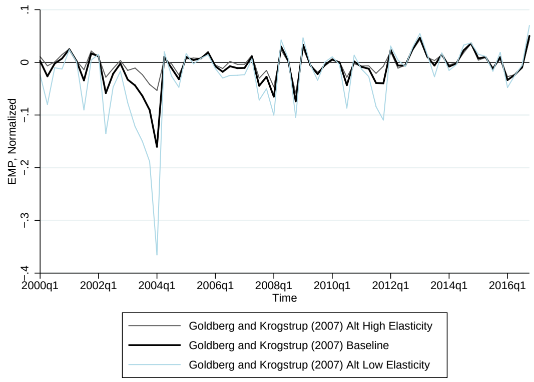
where φ^j are country fixed effects that capture time invariant country specific factors influencing gross capital flows, and τ_t are time fixed effects that capture global factors including risk sentiment, global liquidity, and interest rates, financial conditions and growth in center countries. c is the country grouping for which the elasticity is estimated. In the baseline regression we restrict the elasticities to be the case for all countries, but we also allow for the elasticities to deviate between advanced economies and emerging and developing countries, by interacting all explanatory variables with a dummy taking the value one for emerging and developing countries. The expected signs according to the portfolio rebalancing hypothesis are $\epsilon_e^{c,FA} < 0$ and $\epsilon_e^{c,FL} dlog(e_{t-1}^j) > 0$.

The regression results are presented in Table (6), for the sample period from 2000Q1 to 2016Q4, excluding the crisis quarters of 2008Q3 and 2009Q2.[34]

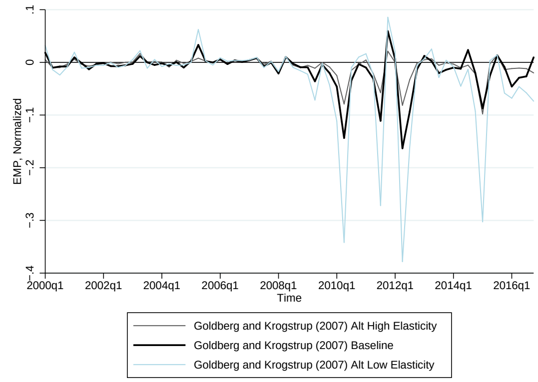
First note that the fit of the regression (R^2) are relatively high for the foreign asset regressions. This primarily reflects a large portion of the variation explained by country and time fixed effects, in turn reflecting structural flows as well as global factors. The domestic interest rate is significant, but with the wrong sign, whereas GDP growth is significant and with the right sign for advanced economies (column II). Moreover, the exchange rate elasticity is significantly negative (column I), suggesting that a 1% exchange rate depreciation against the US dollar should lead to a 0.05% reduction in foreign asset holdings (i.e. a capital inflow due to domestic resident retrenchment). When allowing for the elasticity to differ between advanced countries and emerging and developing countries (column II), significance drops, but the size and sign remain, suggesting that the elasticity is higher for emerging and developing countries.

[34] Avdjiev et al. [2017] present evidence of a structural break in the link between capital flows and global factors around the time of the global financial crisis. We have additionally run the regressions for another three sample periods, namely the pre-crisis period, the post-crisis period, and the full sample including the crisis period, with results differing across these subsamples. Not shown but can be obtained from the authors.

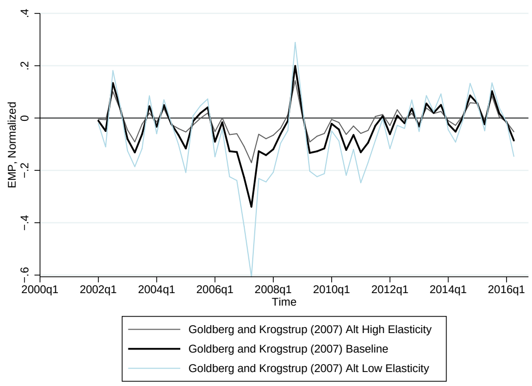
The R^2s for the foreign liabilities regressions (columns III and IV) are substantially lower, and local interest rate and GDP are both insignificant in these regressions. Moreover, the exchange rate elasticity is only significant for emerging and developing countries (column IV), and with the wrong sign.



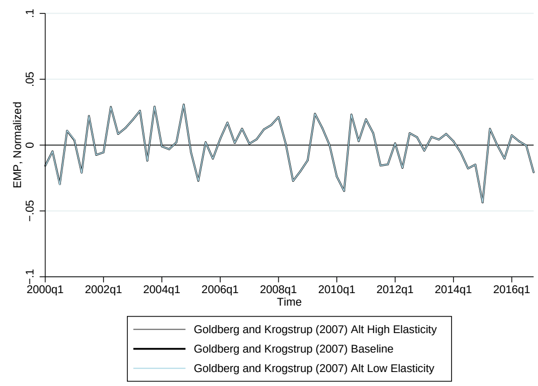
(a) Japan



(b) Switzerland



(c) Brazil



(d) USA

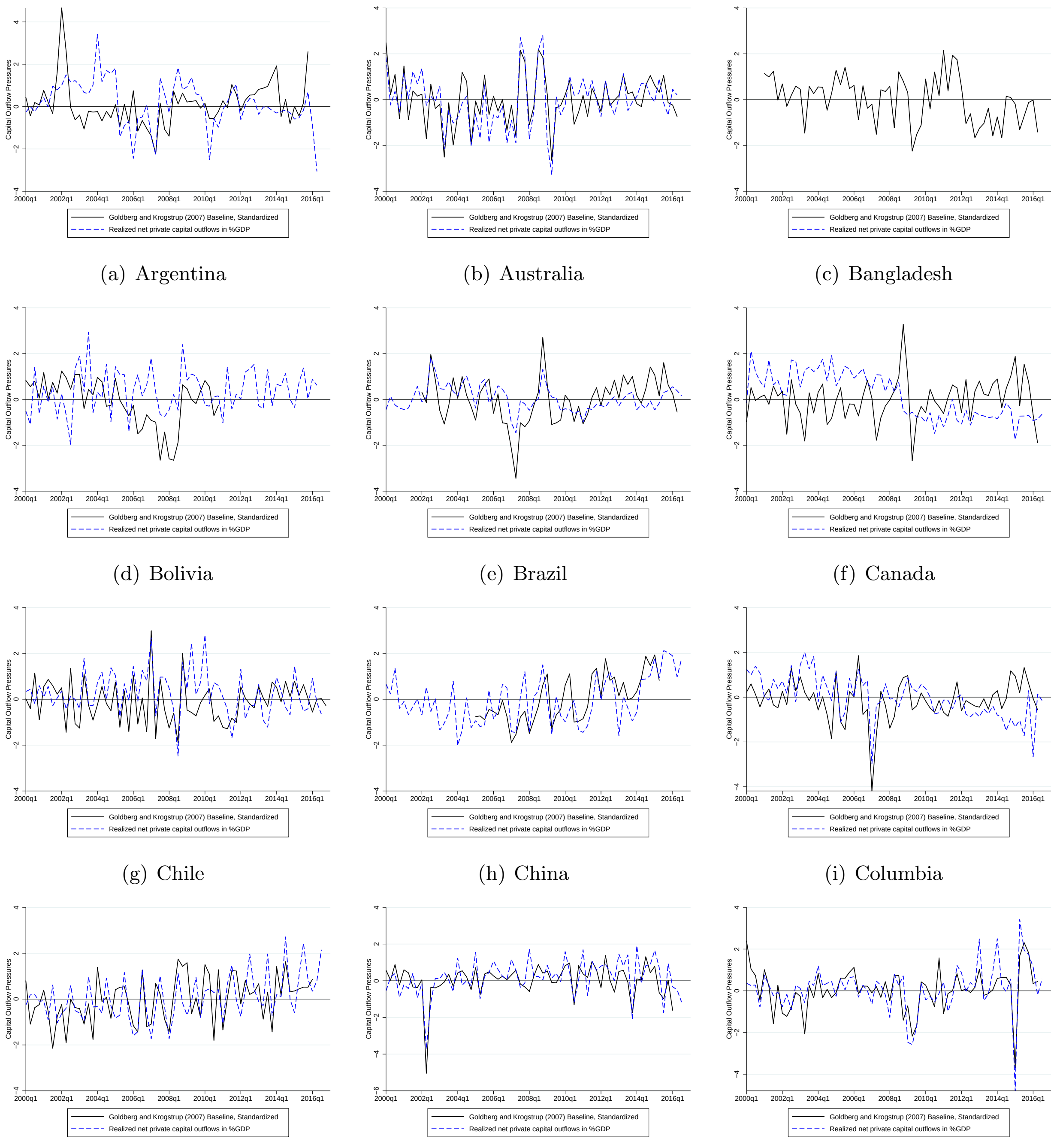
Figure 7: **Baseline EMP and Alternative Elasticity Assumptions.**
The three EMP series are based on different assumptions about the size of the elasticity of gross foreign positions to changes in the exchange rate for constructing the scaling factor Π_e. Baseline is 0.05, the low alternative elasticity is set to 0.005 and the high alternative elasticity is set to 1. EMPs are displayed in quarterly averages of monthly values.

D Sensitivity of EMP to Elasticity Choices

As discussed in Section (4.2), there is considerable uncertainty as to the empirical size of the exchange rate elasticity used to compute Π_e changes. Our baseline EMP is constructed using an elasticity of 0.05. If the true empirical elasticity is lower, the baseline will lead to excessive scaling of reserves changes, and exchange rate changes will unduely denominate the index. If instead the true empirical elasticity is higher, our baseline will tend to underscale reserves changes and lead to excessive dominance of reserves changes in the index. How sensitive is the EMP to changing the elasticity? We find that the extent to which the exchange rate elasticity matters for the EMP depends, again, on the exchange rate regime. Under a floating regime, reserves changes are weighted very low through the valuation adjustment, in which case the scaling of reserves will not matter as the exchange rate component of the index dominates. If the currency is pegged and only reserve changes matter for the EMP, the elasticity does not matter either, as it simply increases or decreases the amplitude of movements in the EMP, which cancel out if the index is normalized. It matters, however, in intermediate regimes, but mainly through changes in amplitudes during specific episodes.

Switzerland is one of the countries for which the elasticity matter the most. We illustrate this in Figure (7), displaying the baseline $EMPs$ and two alternative EMP constructed using half the baseline elasticity size of 0.025 and double the elasticity size of 0.1, respectively for Switzerland. In 2012, when a lower bound for the exchange rate was in place, the Swiss National Bank was intervening strongly in response to exceptional capital inflow pressures associated with the European debt crisis, as suggested by the baseline EMP and the EMP based on an even lower elasticity. The high-elasticity EMP, however, suggests that the capital inflow pressure during that episode was important, but less exceptional than the other measures. As we have no objective measure to compare with, we cannot determine which of these elasticities are more likely to be correct, but are comforted by the fact that they all point to pressures in the same direction.

E Individual Country Charts



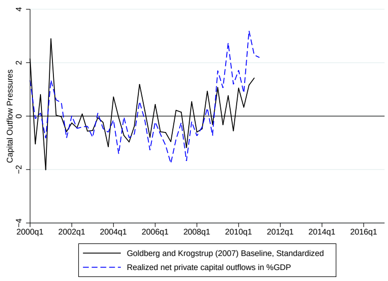
(a) Argentina (b) Australia (c) Bangladesh

(d) Bolivia (e) Brazil (f) Canada

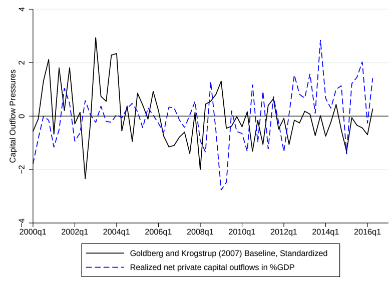
(g) Chile (h) China (i) Columbia

(j) Croatia (k) Czech Republic (l) Denmark

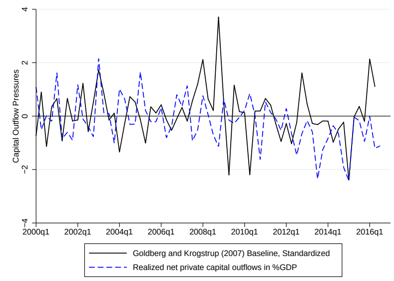
Figure 8: **Net Private Capital Flows in USD and the GK EMP**
Quarterly averages of monthly values of the EMP, constructed vis--vis USD. Net private capital flows from IMF Balance of Payments Statistics. Both series are normalized by their full sample standard deviation.



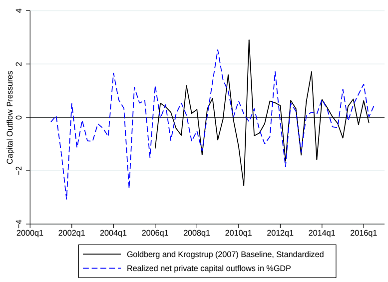
(a) Estonia



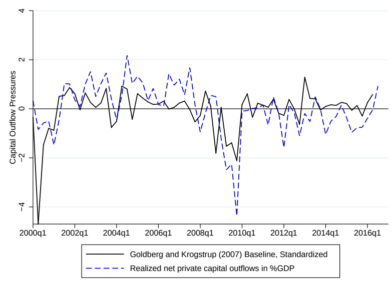
(b) euro area



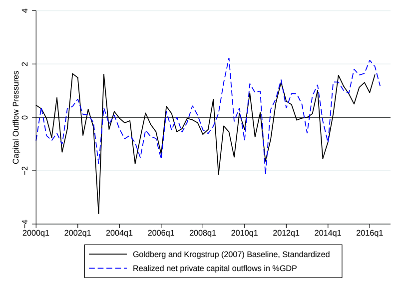
(c) Great Britain



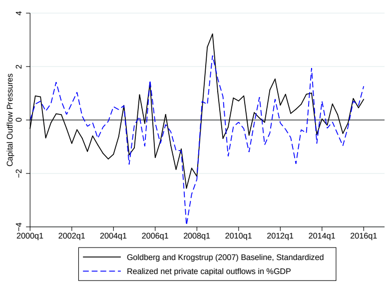
(d) Guatemala



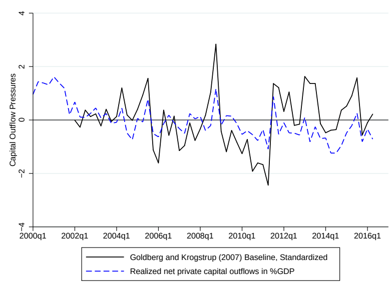
(e) Hong Kong



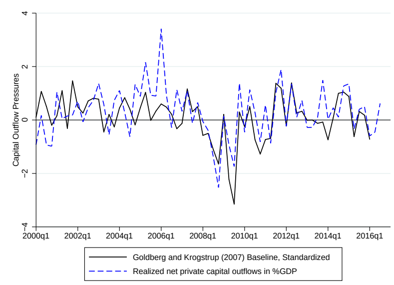
(f) Hungary



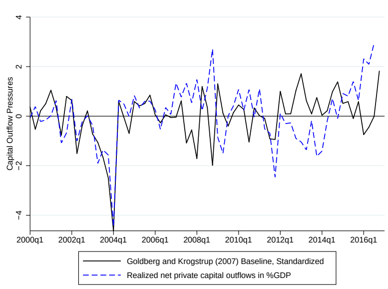
(g) India



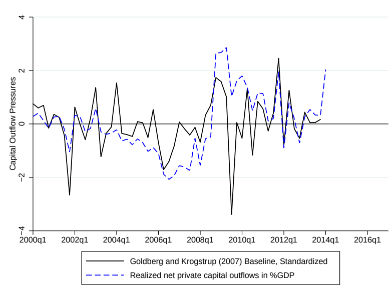
(h) Indonesia



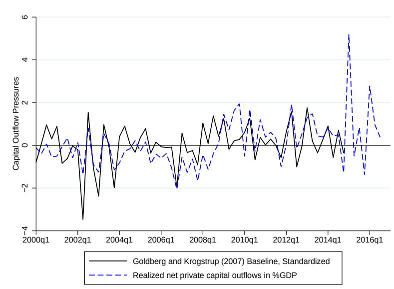
(i) Israel



(j) Japan

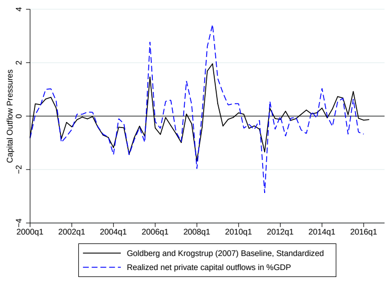


(k) Latvia

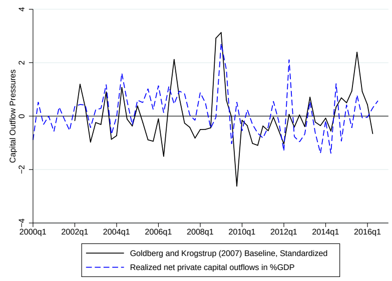


(l) Lithuania

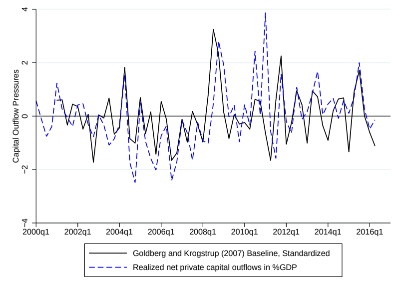
Figure 8: **Net Private Capital Flows in USD and the GK EMP**
Quarterly averages of monthly values of the EMP, constructed vis--vis USD. Net private capital flows from IMF Balance of Payments Statistics. Both series are normalized by their full sample standard deviation.



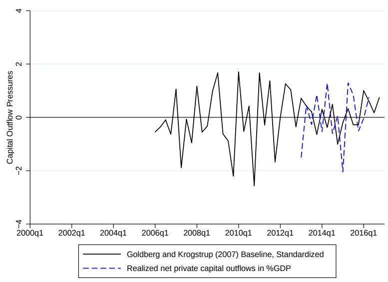
(m) Malaysia



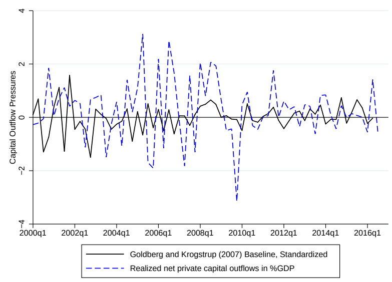
(n) Mexico



(o) New Zealand



(p) Nicaragua



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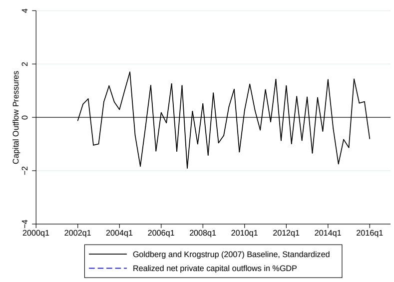
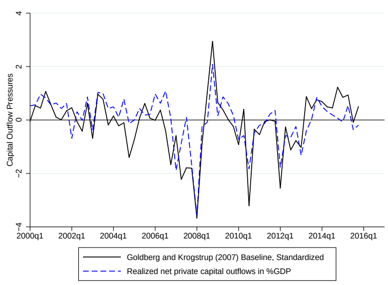
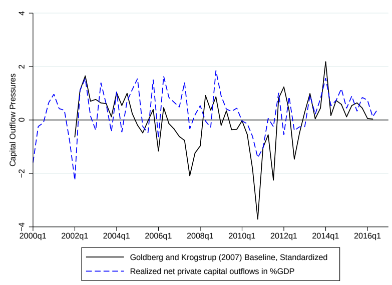


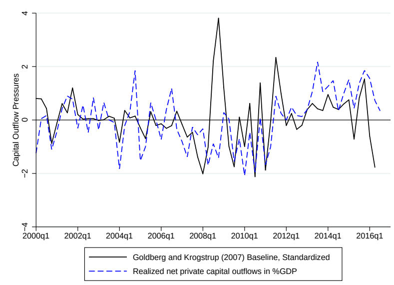
(r) Panama



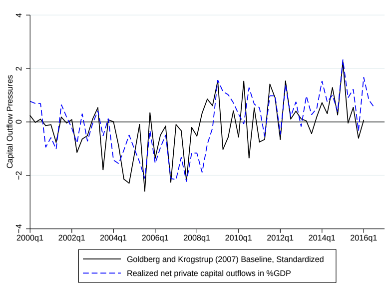
(s) Peru



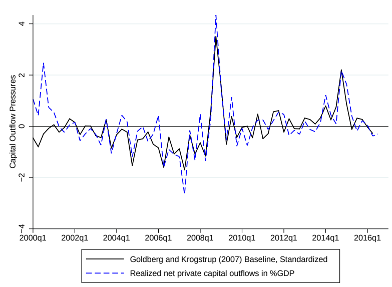
(t) Philippines



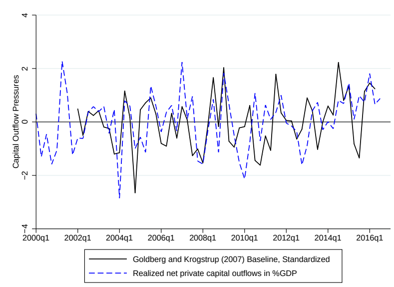
(u) Poland



(v) Romania

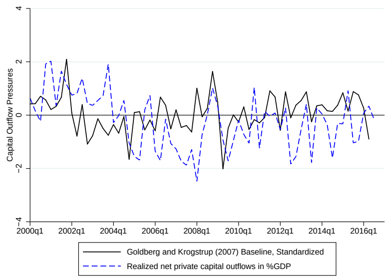


(w) Russia

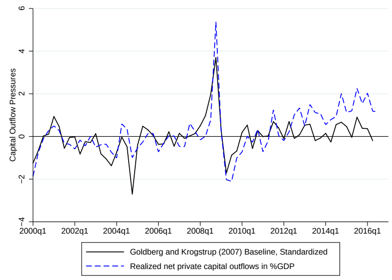


(x) Singapore

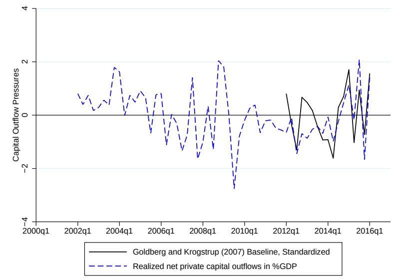
Figure 11: **Net Private Capital Flows in USD and the GK EMP**
Quarterly averages of monthly values of the EMP, constructed vis--vis USD. Net private capital flows from IMF Balance of Payments Statistics. Both series are normalized by their full sample standard deviation.



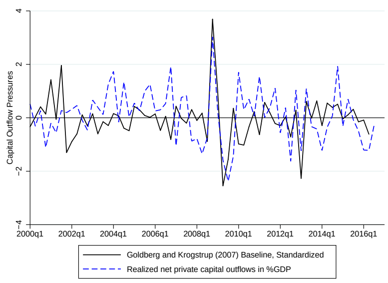
(a) South Africa



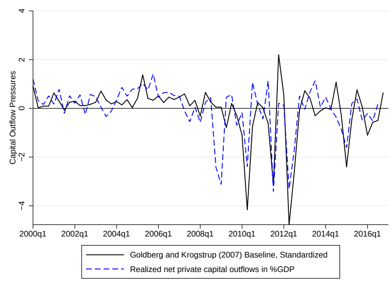
(b) South Korea



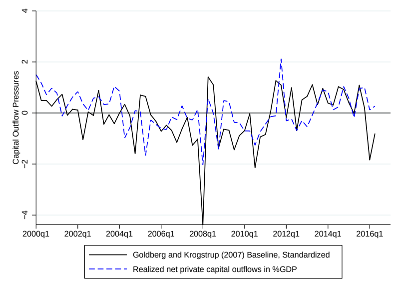
(c) Sri Lanka



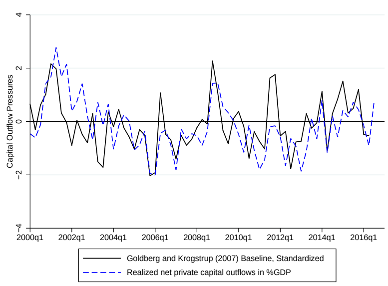
(d) Sweden



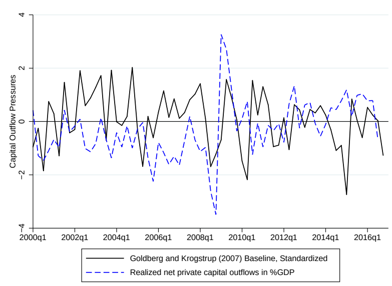
(e) Switzerland



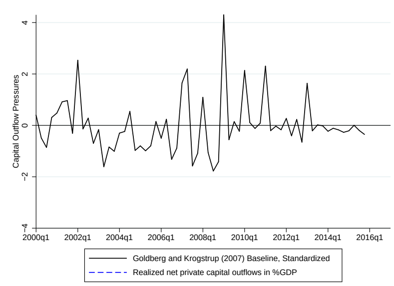
(f) Thailand



(g) Turkey



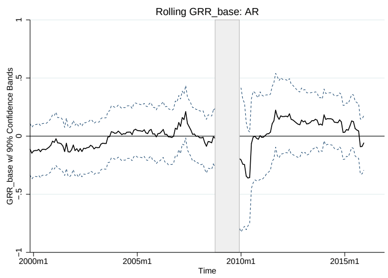
(h) USA



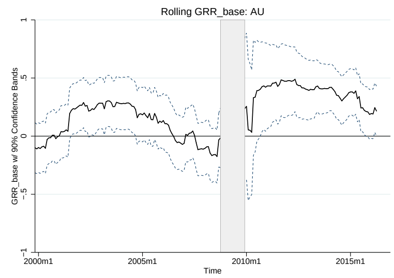
(i) Venezuela

Figure 11: **Net Private Capital Flows in USD and the GK EMP**
Quarterly averages of monthly values of the EMP, constructed vis--vis USD. Net private capital flows from IMF Balance of Payments Statistics. Both series are normalized by their full sample standard deviation.

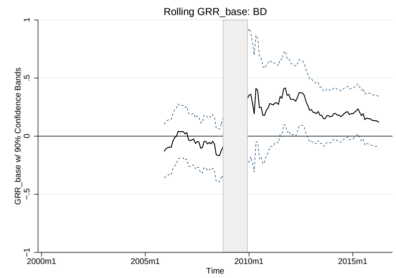
E.1 The GRR



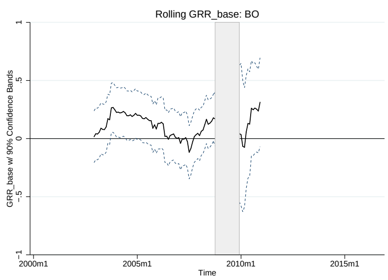
(j) Argentina



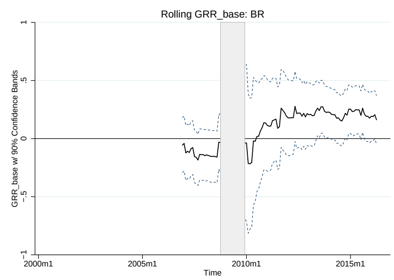
(k) Australia



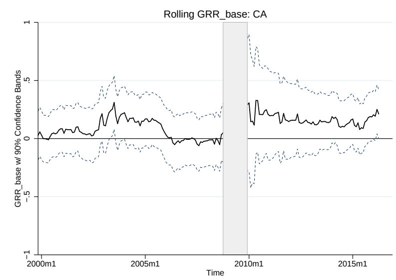
(l) Bangladesh



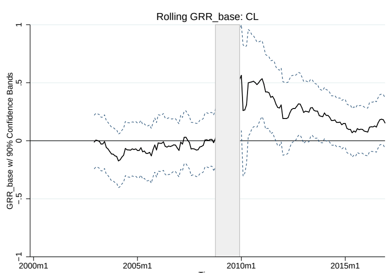
(m) Bolivia



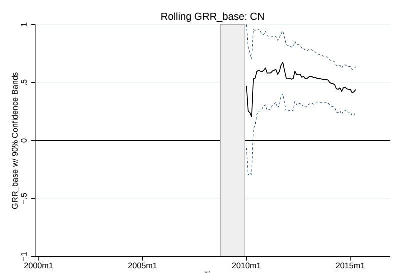
(n) Brazil



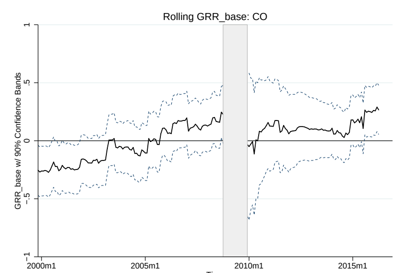
(o) Canada



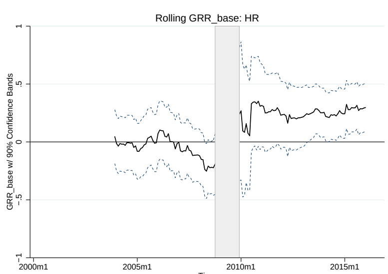
(p) Chile



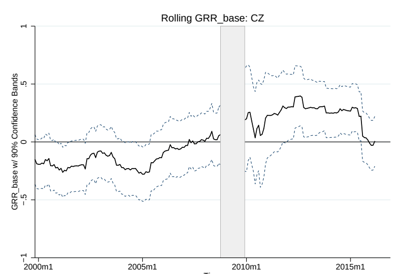
(q) China



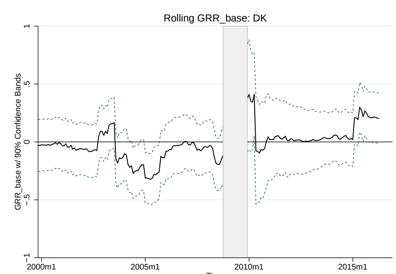
(r) Columbia



(s) Croatia

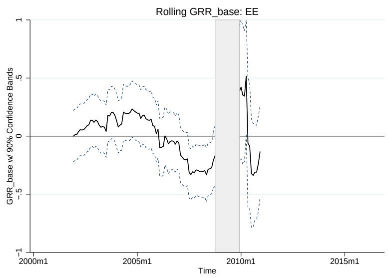


(t) Czech Republic

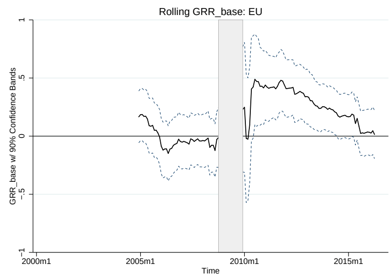


(u) Denmark

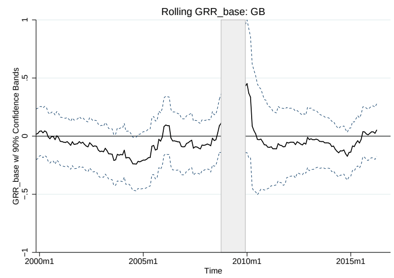
Figure 12: **Global Risk Response (GRR)**
Computation uses the Goldberg Krogstrup EMP constructed vis--vis the KS anchor currency and using the VIX as measure of global factor. Global financial crisis period structural break assumed.



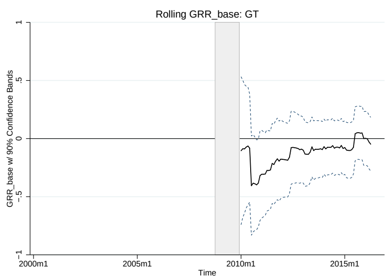
(a) Estonia



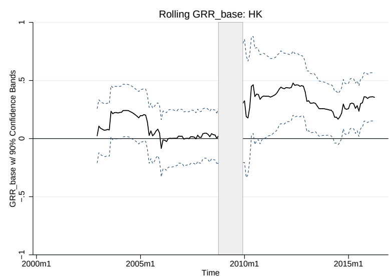
(b) euro area



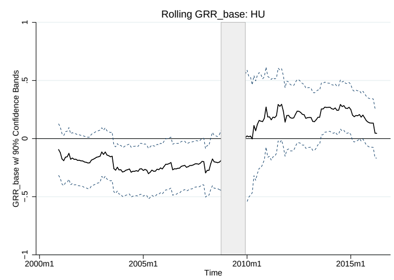
(c) Great Britain



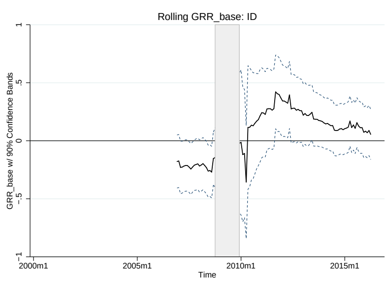
(d) Guatemala



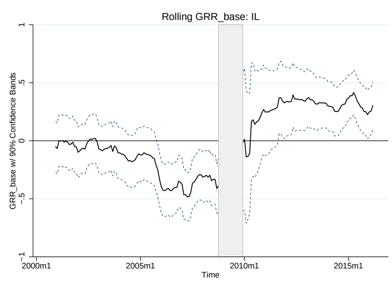
(e) Hong Kong



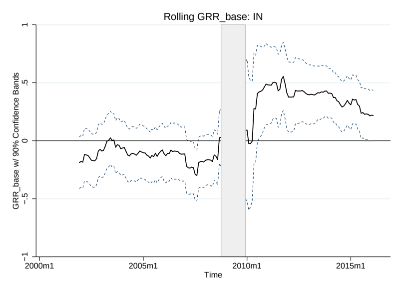
(f) Hungary



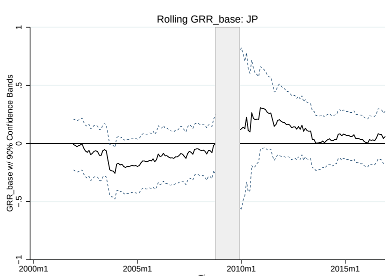
(g) Indonesia



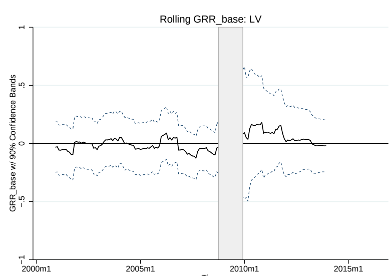
(h) Israel



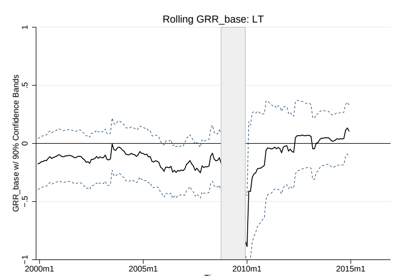
(i) India



(j) Japan

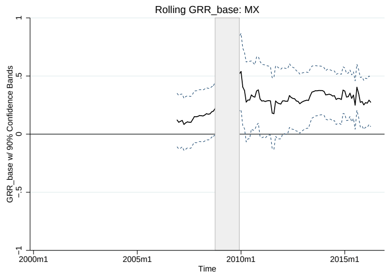


(k) Latvia

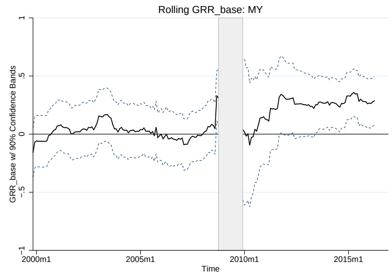


(l) Lithuania

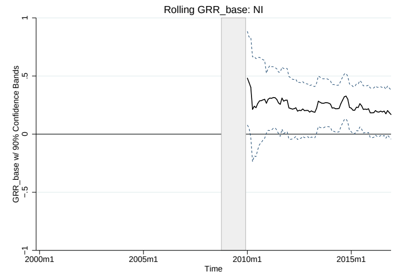
Figure 12: **Global Risk Response (*GRR*)**
Computation uses the Goldberg Krogstrup EMP constructed vis--vis the KS anchor currency and using the VIX as measure of global factor. Global financial crisis period structural break assumed.



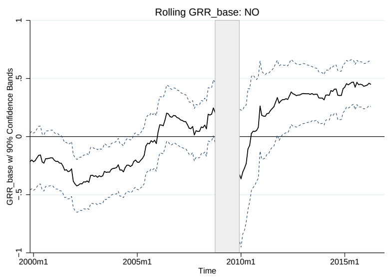
(m) Mexico



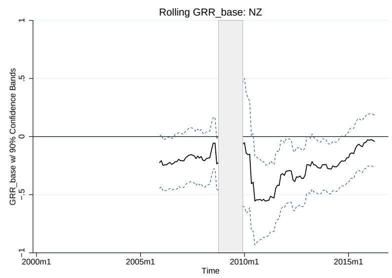
(n) Malaysia



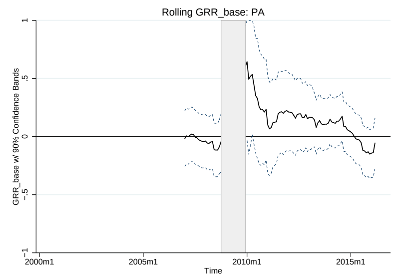
(o) Nicaragua



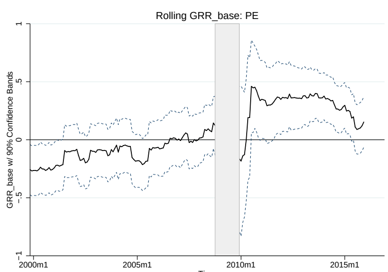
(p) Norway



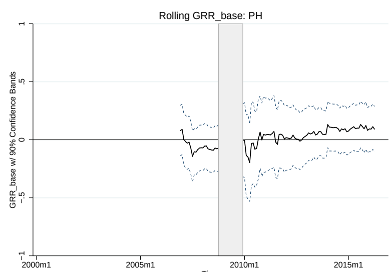
(q) New Zealand



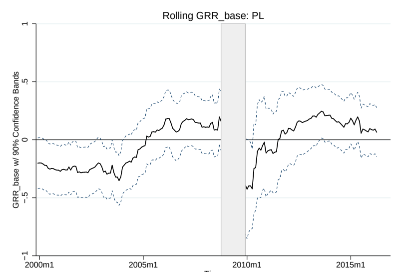
(r) Panama



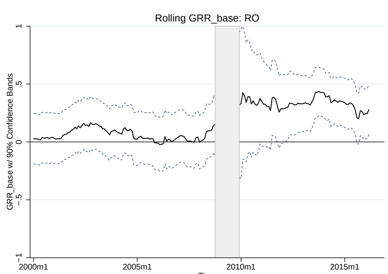
(s) Peru



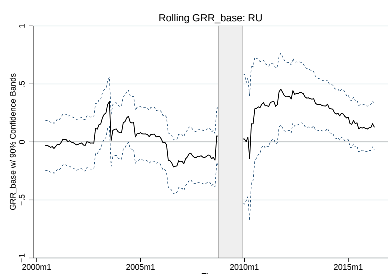
(t) Philippines



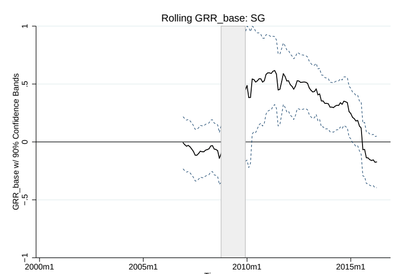
(u) Poland



(v) Romania

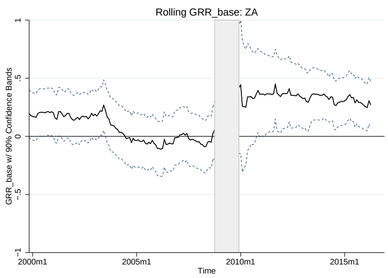


(w) Russia

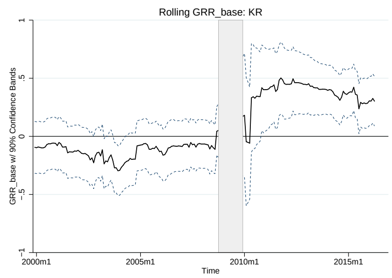


(x) Singapore

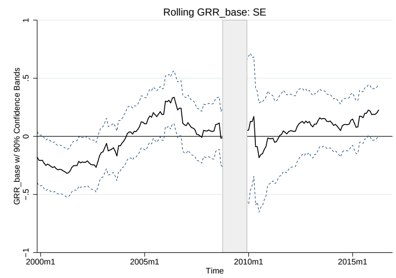
Figure 12: **Global Risk Response (*GRR*)**
Computation uses the Goldberg Krogstrup EMP constructed vis--vis the KS anchor currency and using the VIX as measure of global factor. Global financial crisis period structural break assumed.



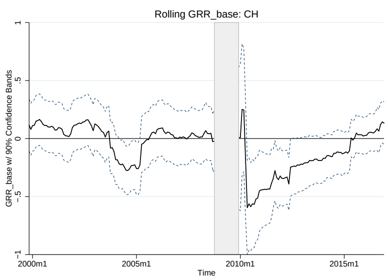
(a) South Africa



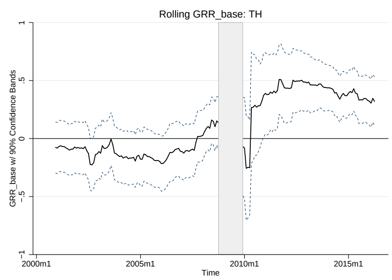
(b) South Korea



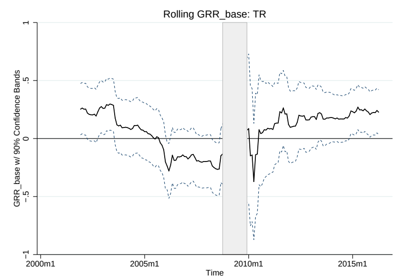
(c) Sweden



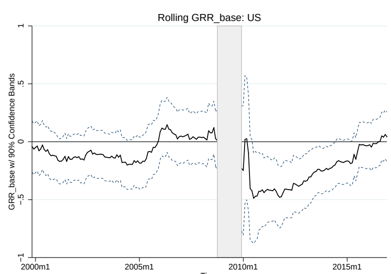
(d) Switzerland



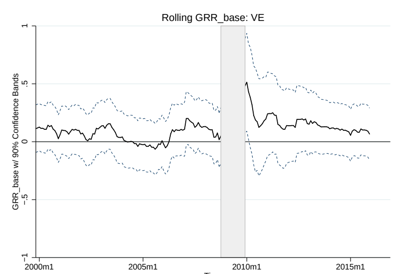
(e) Thailand



(f) Turkey



(g) USA



(h) Venezuela

Figure 12: **Global Risk Response (*GRR*)**
Computation uses the Goldberg Krogstrup EMP constructed vis--vis the KS anchor currency and using the VIX as measure of global factor. Global financial crisis period structural break assumed.